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MUSKMELON CULTURE

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Agricultural Research Service
UNITED STATES DEPARTMENT OF AGRICULTURE

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By S. P. DODLITTLE,
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MUSKMELON CULTURE

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CLIMATE AND SOIL

The muskmelon originated in the hot valleys of southwest Asia. During the early stages of growth the plants need warm weather, ample soil moisture, and a dry atmosphere. Frequent rains or periods of cloudy weather while melons are ripening may lower the quality of the fruit. In humid regions the plants also are more subject to leaf diseases than in a dry climate. When such diseases occur, yields are greatly reduced and melons taken from severely diseased vines are of poor quality even when fully matured. These factors make successful muskmelon culture in humid regions more difficult than the culture of many other vegetable crops.

Although hot, dry weather is particularly favorable to muskmelons, they are adapted to mean monthly temperatures of 65° to 75° F. and can be grown successfully under a variety of climatic conditions. They are an economically important crop in 25 States. However, the favorable effect of the hot, dry atmosphere in the West and Southwest is shown by the fact that over 60 percent of the commercial crop is produced on irrigated land in arid and semiarid areas of California and Arizona. About 12 percent of the crop is grown on irrigated lands in Texas, where it is more humid than in California, Arizona, and districts in Colorado and New Mexico. In these four States muskmelons are grown for shipment.

The remainder of the commercial crop is grown in humid areas in the Central, Southern, and Atlantic States. Georgia, Indiana, Michigan, North Carolina, Ohio, and South Carolina are some of the States that lead in muskmelon production in the East, which in this publication refers to all the region east of the Mississippi River.

Muskmelons generally do best on well-drained, warm, sandy or silt loam. Some fine melons come from sandy river bottoms and from areas of rich clay loam. The commercial crops of Colorado, Arkansas, Texas, Michigan, New Jersey, South Carolina, and Georgia are mostly grown on sandy or less heavy clay loam. Much of the commercial crop of the Imperial Valley of California is grown on silty clay loam.

Muskmelons are intolerant of strongly acid soils, which may produce weak plants that do not properly mature their fruit. When such soils are used, apply lime in sufficient quantities to bring the soil to a slightly acid or nearly neutral condition. Use only the amount of lime indicated by a reliable lime determination, which is made according to the recommendation of

[1] Retired Mar. 31, 1960; deceased Aug. 9, 1961.

the county agricultural agent or the State agricultural experiment station.

The plants will not tolerate excessive water and should not be grown where water stands in furrows for some time after a rain or where the soil is easily washed away. Any good garden soil may be used to grow muskmelons for home use in localities where length of season and climate are favorable.

CROP ROTATION

Crop rotation helps to reduce loss from diseases caused by soilborne organisms and to keep the soil in productive condition both as to plant nutrients and texture. A rotation in which no muskmelons, cucumbers, watermelons, or squash are grown oftener than once in 3 years helps to reduce losses from diseases caused by soilborne fungi or bacteria. Where root knot is prevalent, do not plant cucumbers, watermelons, tomatoes, and other susceptible crops in a short rotation with muskmelons.

VARIETIES AND STRAINS

All varieties of muskmelons belong to the species *Cucumis melo*, which includes several botanical varieties. From a botanical standpoint the term "cantaloup" applies only to melons with a rough, warty surface, pronounced ribs, and a hard rind. They belong to a botanical variety, *cantaloupensis*, which is not grown in the United States. However, the melons with netted, green and yellow-green rinds of the botanical variety *reticulatus* are called cantaloups by the American public, growers, and the marketing trade. A third botanical variety, *inodorous*, includes the Honey Dew, Honey Ball, Casaba, and Persian melons. These are the so-called winter muskmelons, which are late maturing, have a firm, thick flesh, and can be stored for some time.

CHOOSING A VARIETY

In choosing a variety or varieties to plant, select those known to be adapted to the soil and climate where they are to be grown and also those that will be acceptable to the market for which they are intended. Muskmelons grown in California and the Southwest for distant shipment are mainly the "cantaloup" varieties that are only slightly ribbed, broadly oval or round, and heavily netted. The American public prefers medium-sized melons, 4 to 5 inches in diameter, with thick, uniformly deep-orange flesh. In the East many of the netted varieties are grown for medium-distance shipping, local markets, and roadside stands. In such markets larger and more deeply ribbed melons are often preferred and, to a limited extent, green-flesh varieties.

The melons of the semikeeping or so-called winter varieties require a long growing season and are best suited to the hot, dry, irrigated sections of the West and Southwest. This group includes the Honey Dew and Honey Ball, which are grown extensively for distant shipment and local markets, and the Persian and Casaba, which are popular local-market melons that can be shipped if carefully handled.

The use of disease-resistant varieties often is essential to successful production of muskmelons. Varieties resistant to powdery mildew are extensively used in California and the Southwest, where this disease is very damaging to susceptible varieties. There are varieties with considerable resistance to downy

mildew, although no commercially suitable varieties that are generally adapted to the Atlantic and Gulf States, where this disease is most prevalent. The use of varieties resistant to fusarium wilt has reduced losses in areas in the Eastern and Central States, where this disease is serious.

Muskmelon varieties are so numerous that a complete listing here would be impractical. Those in most demand for commercial and home-garden planting are briefly described. They have been grouped into generally adapted varieties and late-maturing varieties adapted only to a hot, dry climate.

GENERALLY ADAPTED VARIETIES

Delicious 51.—About 83 days.[2] Resistant to fusarium wilt. Fruit round, about 6 inches in diameter, with wide, prominent ribs. Rind light creamy yellow at maturity, solid, coarsely netted. Flesh orange, thicker and firmer than that of original Delicious, sweet. Popular as substitute for Delicious in New York and other short-season areas where wilt resistance is desired.

Hale Best Jumbo.—About 86 days. Fruit oval, about 7 by 6 inches,[3] slightly ribbed. Rind firm, heavily netted. Flesh deep salmon orange, thick, good flavor. Popular melon for local markets and medium-distance shipping in Southeastern and Northwestern States.

Hale Best 36.—About 83 days. Slightly smaller than original Hale Best variety. Fruit of uniform size, about 6 by 5½ inches, indistinct ribbing. Rind very firm, heavily netted. Flesh salmon, firm, very thick, sweet. Small seed cavity. Popular shipping and market melon in Southeastern States.

Hearts of Gold (*Hoodoo*).—About 92 days. Fruit almost round, about 6½ by 6 inches, shallow ribbing. Rind deep green, with heavy, grayish netting. Flesh deep salmon orange, medium thick, with sweet, aromatic flavor. Small seed cavity. Midseason variety popular with market and home gardeners in Midwestern and Eastern States.

Honey Rock.—About 84 days. Fruit round, about 5 by 6 inches, faint ribbing. Rind gray green, hard, with coarse netting (fig. 1). Flesh deep salmon, medium thick, with sweet, musky flavor. Fusarium wilt-resistant strain has been developed; similar to older strain, but fruit is more heavily netted and has thicker flesh. Relatively early variety, popular for local markets and home-garden use in North Central States.

Iroquois.—About 90 days. Resistant to fusarium wilt. Fruit round to slightly flattened, about 7 by 6 inches, prominent ribs. Rind gray green, tough, with coarse, prominent netting. Flesh deep orange, thick, with fine texture and sweet, musky flavor. Popular for home and market gardens in Northeastern States.

Powdery Mildew-Resistant Cantaloup No. 45 (*PMRC No. 45*).—About 88 days. Resistant to race 1 but not race 2 of powdery mildew fungus. Fruit broadly oval, about 5½ by 5 inches, slight ribbing (fig. 2). Rind green, yellow green at maturity, hard, well netted. Flesh salmon orange, thick, firm, sweet, with excellent flavor. Seed cavity small. Resembles Hale Best (one of its parents). Leading variety for long-distance shipment in long-season areas of West and Southwest where powdery mildew is not severe; also popular in Southeast.

Powdery Mildew-Resistant Cantaloup No. 6.—About 95 days. Resistant to all known races of pow-

[2] In each varietal description the number of days indicates the length of time from seeding to the first ripe fruit.

[3] In the fruit measurements, the length is always given first.

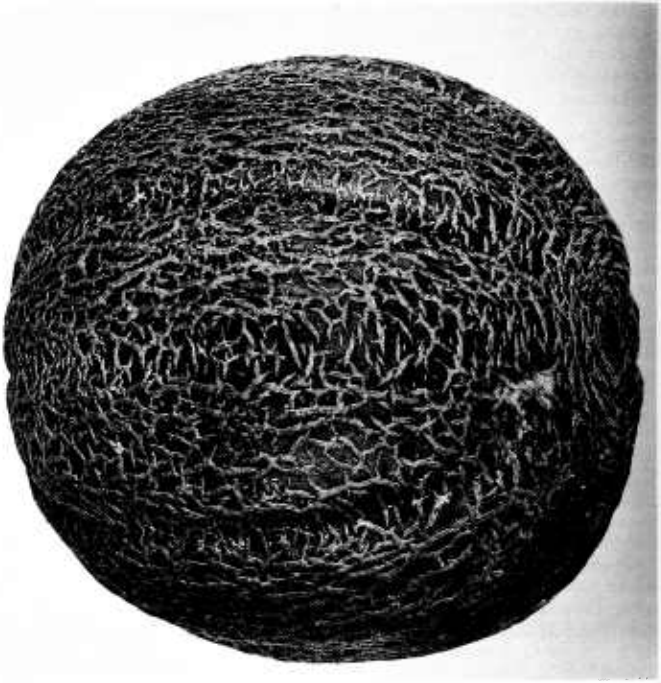

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FIGURE 1.—Honey Rock muskmelon.

dery mildew fungus. Fruit nearly spherical, 5½ by 5 inches, slightly ribbed (fig. 3). Rind similar to that of PMRC No. 45. Flesh light salmon orange, thick, firm, moderately sweet. Seed cavity small. Extensively used for distant shipment in long-season areas of Rio Grande Valley in California and Arizona, where PMRC No. 45 is damaged by powdery mildew.

Powdery Mildew-Resistant Cantaloup No. 450.—About 95 days. Resistant to race 1 of powdery mildew fungus. Similar to PMRC No. 45, but fruit is larger, about 6 by 6½ inches, more prominently ribbed. Flesh salmon, firm, sweet. Long-season variety for distant shipping when large melon is desired. Grown in California and Southwest.

Pride of Wisconsin (*Queen of Colorado*).—About 90 days. Fruit slightly oblong, about 6 by 5½ inches, distinct ribs. Rind light gray, tough, with heavy, coarse netting. Flesh bright orange, very thick. Small seed cavity. Widely used for short-distance shipping, local markets, and home gardens in North Central States.

Rio Gold.—About 90 days. Tolerant of downy mildew and some resistance to powdery mildew. Fruit round-oval, about 6 by 5½

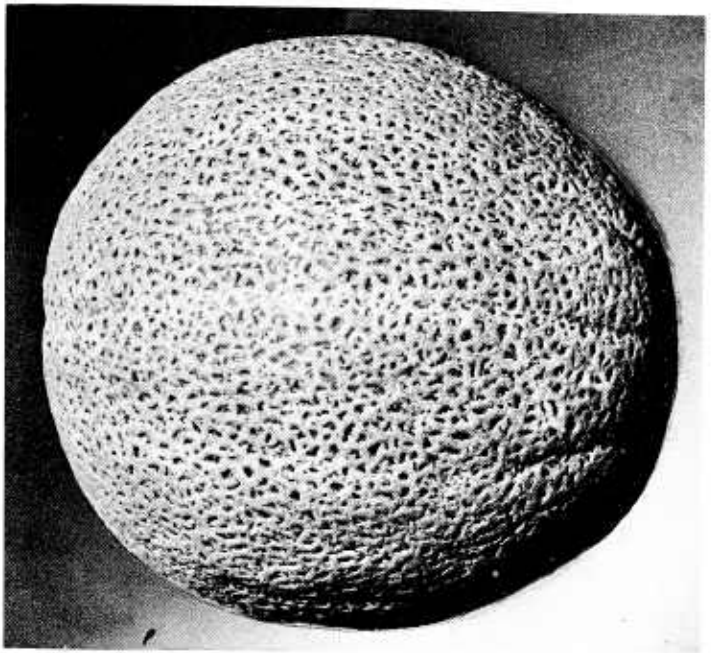

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FIGURE 2.—Powdery Mildew-Resistant Cantaloup No. 45.

inches, shallow ribbing. Rind mottled gray green and dark green, yellow at maturity. Flesh orange, thick, rather tender, excellent flavor. New variety suitable for short- or medium-distance shipping, local markets, and home-garden use in Texas and Southeastern States.

Rocky Ford (Netted Gem).—About 90 days. Fruit nearly round, about 5½ by 5 inches, indistinct ribbing. Rind firm, uniformly covered with heavy, gray netting. Flesh green, shading to salmon at center, thick, juicy, sweet. Old variety still popular for local markets and home-garden use in many sections of United States.

Schoon Hardshell.—About 90 days. Fruit oblong, about 6½ by 5½ inches, deep ribs. Rind golden yellow at maturity, hard, firm, with coarse netting. Flesh deep salmon, thick, sweet, with slightly musky flavor. Hard rind and good keeping quality make it excellent variety for shipping to nearby markets and for home gardens. Grown in Midwestern, Southeastern, and Northeastern States.

Smith Perfect.—About 95 days. Resistant to downy mildew. Fruit round or slightly flattened at stem end, about 6 inches in diameter, almost no ribs. Rind dark green, bright greenish yellow when ripe, firm. Flesh deep orange, medium thick, juicy, with good flavor.

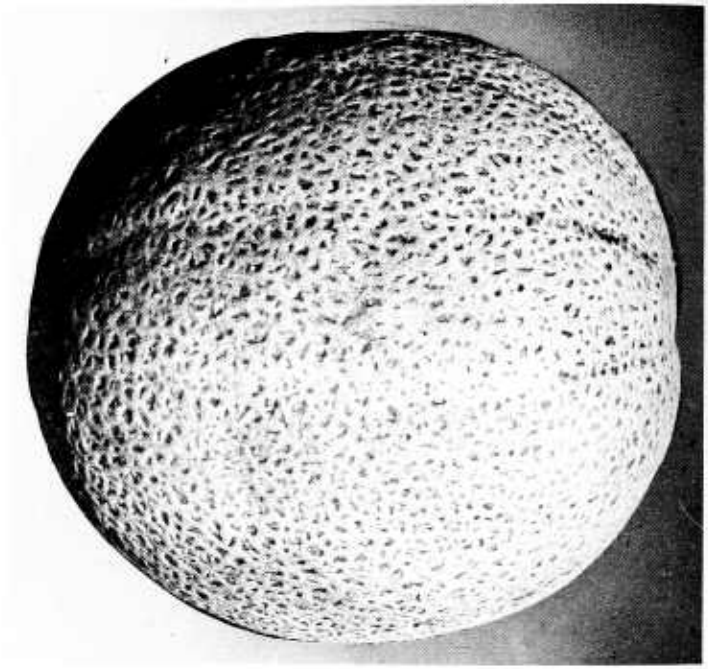

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FIGURE 3.—Powdery Mildew-Resistant Cantaloup No. 6.

Small seed cavity. Popular in certain areas of Florida for home gardens and local and distant shipping.

SR No. 91 (Sulfur Resistant).—About 90 days. Tolerant of sulfur applied to control powdery mildew. Fruit short-oval, about 6½ by 5½ inches, slight ribbing. Rind hard, heavily netted. Flesh salmon, thick, sweet. Small seed cavity. Shipping and local-market melon for areas in Southwest where powdery mildew is prevalent and resistant varieties do not meet needs of grower.

SR No. 91 (Sulfur Resistant) Smaller Fruited Strain.—Fruit similar to that of regular variety, but has less ribbing. This strain produces higher percentage of size 36 fruit.

VARIETIES ADAPTED ONLY TO A HOT, DRY CLIMATE

Crenshaw.—About 115 days. Fruit smooth, somewhat pear shaped, about 7 by 6 inches, without ribs; mature fruit remains attached to stem. Rind dark green when immature, yellow tan when ripe, thin, soft, with or without thin netting (fig. 4). Flesh salmon orange, thick, with distinctive sweetness, high quality. Long-season melon of Casaba type suitable for growing in irrigated areas of West and Southwest where powdery mildew is not prevalent. Local-market melon primarily, but fruit can be shipped if carefully handled.

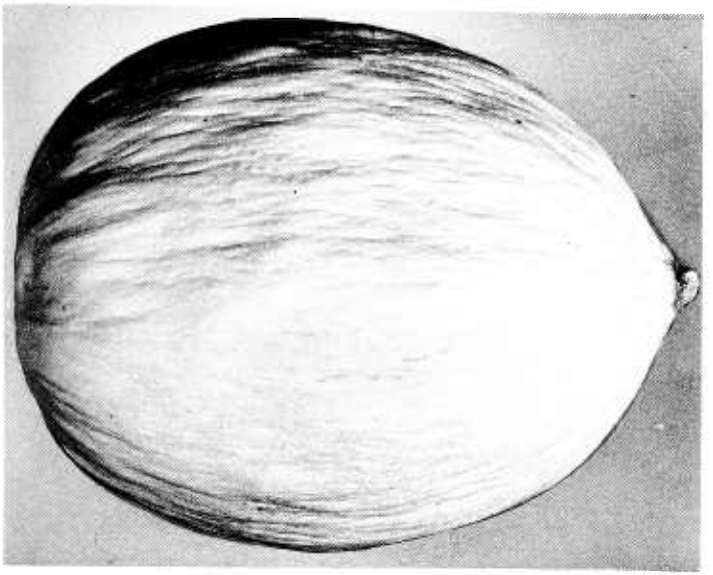

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FIGURE 4.—Mature fruit of Crenshaw muskmelon.

Golden Beauty (*Casaba*).—About 110 days. Fruit globular, pointed stem end, about 6 to 8 inches in diameter, without ribs; mature fruit remains attached to stem. Rind golden yellow during ripening, wrinkled, longitudinal corrugations, no netting (fig. 5). Flesh white, thick, firm but juicy, sweet, with distinctive flavor. Susceptible to powdery mildew. Keeps for some time if stored properly. Does not tolerate extremely high temperature during harvest. Popular home-garden and local-market melon. Suitable only in long-season areas of West and Southwest.

Honey Ball (*Melo Gold*).—About 105 days. Fruit globular, 5 inches in diameter. Rind yellowish white, nearly smooth, slight but even netting. Flesh deep salmon orange, thick, fine texture, characteristic sweet flavor. Keeps well in storage. Long-season melon suitable only for areas of West and Southwest. Withstands distant shipment if carefully handled during harvesting, packing, and shipping.

Honey Dew.—About 115 days. Fruit round to broadly oval, about 8 by 7 inches, smooth; mature fruit remains attached to stem. Rind greenish white, creamy yellow when ripe (fig. 6). Flesh light green, thick, fine grained, juicy, with distinctive sweetness. When properly ripened, can be stored for some time. Requires long season and hot climate; does best under semiarid conditions with irrigation. Grown for distant shipment and local markets in West and Southwest. Distinct type of melon. No strain particularly successful in Eastern or Southern States.

Persian.—About 115 days. Fruit globular, 7 to 10 inches in diameter,

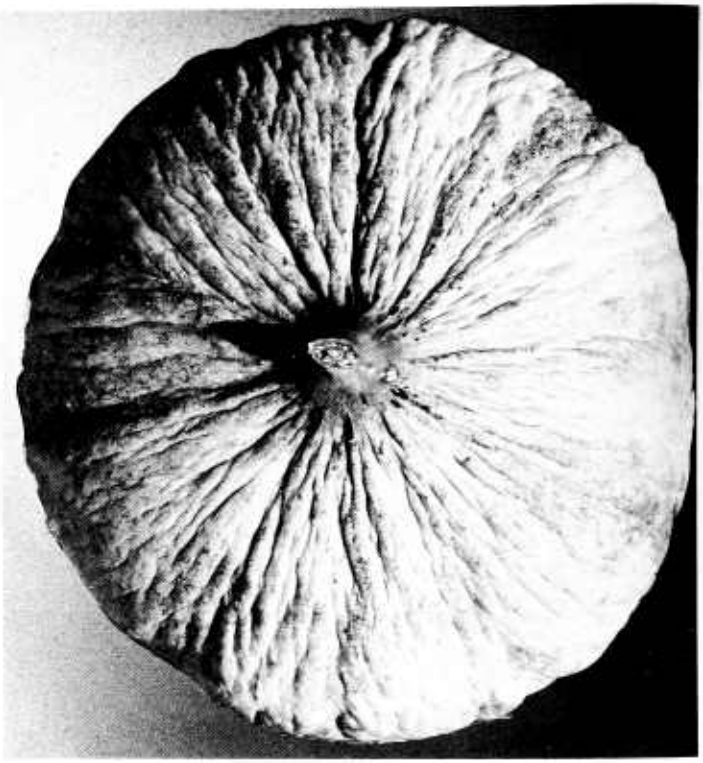

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FIGURE 5.—Golden Beauty (Casaba) muskmelon.

without ribs; separates from stem at full maturity, soon becomes overripe. Rind dark green, abundant thin netting well distributed (fig. 7). Flesh bright orange, thick, sweet, with distinctive flavor. Seed cavity moderately large. Does not do well at high temperatures during harvest. Popular local-market melon, shipped to some extent. Best suited to certain irrigated areas in Southwest.

Small Persian.—About 110 days. Typical fruit 4 to 5 inches in diameter, similar to Persian in appearance, color, quality of flesh. Seed cavity small. Adapted to same uses and grown in same areas as Persian. Several small-fruited strains have been introduced.

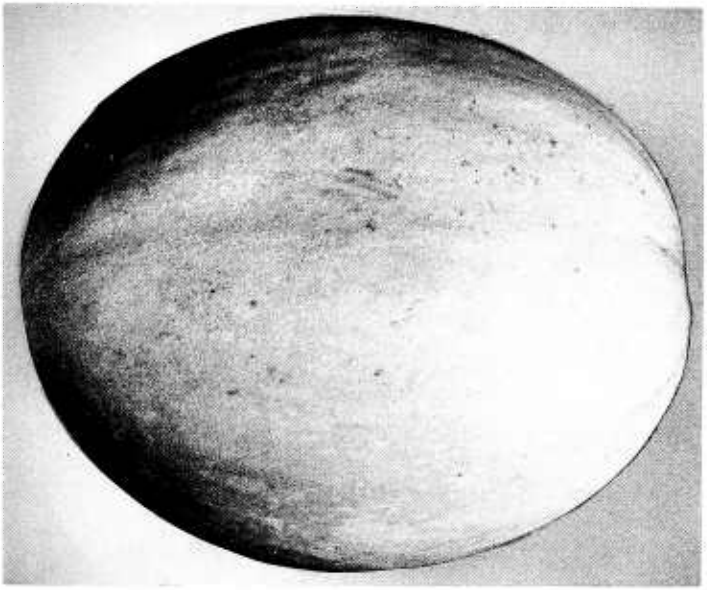

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FIGURE 6.—Honey Dew muskmelon.

SEED SUPPLIES

The first essential for growing a profitable crop of muskmelons is to use high-quality, viable seed from a reliable source. Seed of inferior or unknown quality may be of low vitality or produce a high percentage of offtype plants and fruit. Some viruses affecting muskmelons are seedborne. Care and experience on the part of the seedsman are required to produce virus-free seed of high quality. Ample supplies of high-grade seed true to varietal type are produced in areas in the West where climatic conditions aid in keeping the plants free from certain disease-producing fungi, which often are carried on the seed.

There is no foundation for the belief held by some growers that muskmelons cross with cucumbers, watermelons, pumpkins, or squash. However, different varieties of muskmelon do cross with each other. Bees are the most common and effective pollinators of muskmelons. For effective isolation, locate seed plots one-half mile or more from any other muskmelon planting.

When muskmelons are grown for large-scale commercial production of seed, they are planted and cared for in much the same way as when they are grown for marketing of the fruit. However, the fields are carefully examined from time to time, and plants that are weak, diseased, or not true to type are discarded. When the melons are fully ripe, they are harvested. The seed is removed

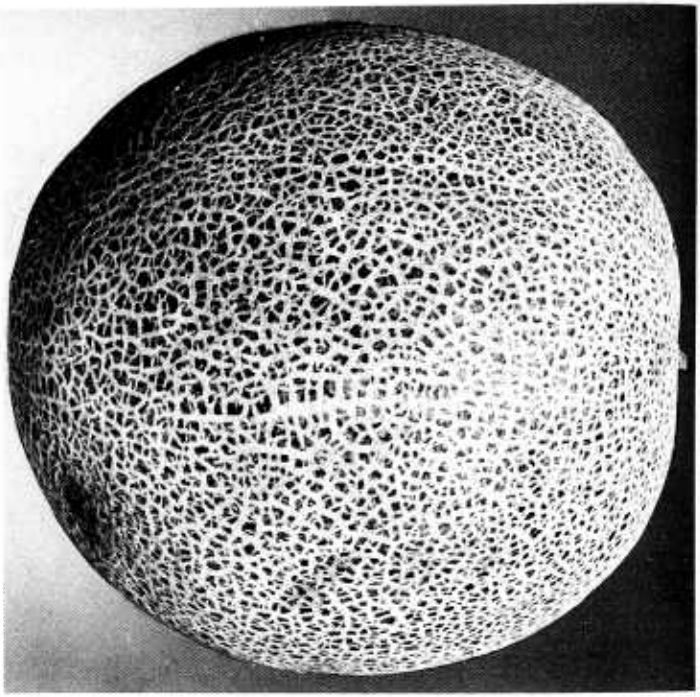

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FIGURE 7.—Persian muskmelon.

by machines that are operated in the fields. It is washed and dried by machines shortly after it is taken from the fields.

PREPARING AND FERTILIZING THE SOIL

To prepare a field for successful muskmelon growing, plow deeply and early enough to let the soil settle thoroughly before planting time. Plow in the fall or the winter land that is in sod or on which a cover crop precedes the muskmelons, so that plant material that has been turned under may decay sufficiently before planting.

In the Central and Eastern States muskmelons usually are grown by level culture. Under normal conditions there is no advantage in bedding up well-drained sandy soil for growing muskmelons, but on low river-bottom or alluvial soil, bedding is necessary. Make the beds 5 to 7 feet wide and plant one row on each bed. In parts of the Atlantic and Gulf regions where excessive rains frequently occur early in the summer, it is desirable to plow the land in 5- or 6-foot beds, with open furrows between to give better drainage.

In the West and Southwest the plants for the early-spring crop are started on the south slope of beds that run east and west. These beds are 2 to 2½ feet high and 5 to 7 feet apart from center to center. The height and shape of the beds expose a large surface to the winter sun, protect the young plants from the wind, and keep the vines above the level of the irrigation water applied in furrows between the beds. The summer crop usually is grown either with no bedding and no irrigation or with slight bedding and irrigation.

In humid areas where plantings are made on rolling land or where there is danger of excessive erosion, lay out beds or rows on the contours. This arrangement is especially desirable in localities where drought is likely, because it prevents rapid runoff of water and conserves moisture for the plants to use later.

A plan followed by many western growers is to have field roads about 400 feet apart at right angles to the rows. In the East a space commonly is left after every seventh to tenth row to permit passage of spray equipment and trucks.

After plowing the soil of level fields, thoroughly cut it with a disk harrow about a month before planting so that it will settle. Just before planting go over the field with a smoothing harrow. The type of harrow that crushes, turns, and pulverizes the soil in one operation is excellent for this final preparation. On extremely loose or sandy soil an ordinary spike-tooth, smoothing harrow is desirable. Land graded for irrigation requires extra leveling and floating to give the desired slope. For raised beds, give the land the same preliminary preparation and make it into beds about a month before planting. Then harrow and smooth the south side of the beds just before planting.

In growing muskmelons, the use of manures and commercial fertilizers is governed by the locality and the type of soil. The plants grow best on soil well supplied with organic matter, which can be maintained or increased by applying manure if it is available at a reasonable cost or by plowing under soil-improving crops, such as alfalfa, clover, cowpeas, or soybeans.

Most of the muskmelon crop is grown without manure, but manure is a valuable fertilizer when it can be obtained in sufficient quantities. It is especially valuable in the arid interior valleys of California where soil is low in organic matter. When available at a moderate cost, stable or feed-lot manure can be broadcast in the spring before plowing at rates of 10 to 15 tons per acre. If applied and worked well into the soil after plowing, smaller amounts can be used effectively by spreading well-rotted manure in strips 4 feet wide where the rows are to be located. The same can be done with some bedded fields by driving the spreader astride the bed.

Another method is to lay off rows with a plow or middlebuster, to apply well-rotted manure in the furrows in small piles accurately spaced for the hills, and then to use the plow or middlebuster again to form a slight bed over the manure. With this method, first mark lines across the field to show the spacing of the hills, open furrows at right angles to these lines, and place the manure at the intersections.

Commercial fertilizers are almost always necessary for growing muskmelons on a large scale. The kind and quantity to be used depend on the type of soil, the use of cover crops, and the amount of fertilizer previously applied. Consult your State experiment station or county agricultural agent before selecting the fertilizer and the method of application. After fertilizing the beds, harrow and smooth them just before planting.

In the East it is usually profitable to apply 600 to 1,000 pounds per acre of a fertilizer containing 6 to 12 percent of nitrogen, 8 to 12 percent of phosphoric acid, and 6 to 12 percent of potash, although the relative proportions vary with the type of soil.

On fertile loam that has been heavily fertilized or on which a leguminous crop has been grown the previous season, 500 to 700 pounds of fertilizer per acre is usually sufficient. Broadcast half of this amount before plowing and the remainder after plowing. On similar sandy loam broadcast 500 to 800 pounds per acre after plowing. On less fertile loam and sandy soil apply 600 to 1,000 pounds per acre after plowing. Where manure has been applied, 300 to 400 pounds per acre of a 4–8–8 mixture can often be profitably applied before planting.

In the Middle Atlantic States some growers apply 500 pounds of fertilizer per acre, either broadcast or in a strip along each row when they are preparing the land. During the growing season this is followed with two side dressings of 200 to 300 pounds per acre each. The first side dressing is drilled about a foot from the plants when they begin to run; the second is applied at the last cultivation.

In the Southwest the soil generally is high in potash, but melons require nitrogen and often respond to phosphoric acid. The amounts of nitrogen used vary from 60 to 150 pounds per acre depending on the soil. If nitrogenous fertilizers have been applied to the preceding crop, the plants may not need additional nitrogen. When dry forms of nitrogen are used, one-half to two-thirds can be applied before planting and the remainder as a side dressing when the vines begin to run.

Another method is to apply the entire amount of nitrogen before planting in either one or two bands a few inches from the seed row and a few inches below it. If a single band is used, the nitrogen is placed in the bed between the seed and the irrigation furrow—a few inches from the seed row and about 6 inches below it. If two bands are used, one is placed as described and the other about 6 inches to the opposite side of the seed row and about 8 inches below. Equivalent amounts of liquid or gaseous nitrogen can be applied in the irrigation water.

Phosphate is preferably applied at or before planting in amounts giving 60 to 120 pounds of phosphoric acid per acre. Liquid phosphate fertilizer can be applied in equivalent amounts in the irrigation water or in the bed in bands by means of special equipment.

METHODS OF PLANTING

Since muskmelon seeds do not germinate well at low temperatures and the seedlings are very tender, delay planting in the open until the soil becomes warm and there is no danger of frost. Most of the commercial crop is grown from seed planted in the field, but in some localities the plants are started in greenhouses, hotbeds, or sash-covered frames and transferred to the field when weather conditions become favorable. This method is suitable for comparatively small acreage, especially in market-garden sections where growers wish to mature some melons very early or where late frosts are so severe that paper covers do not adequately protect the plants and the frost-free season is too short for growing a crop from seed planted in the field.

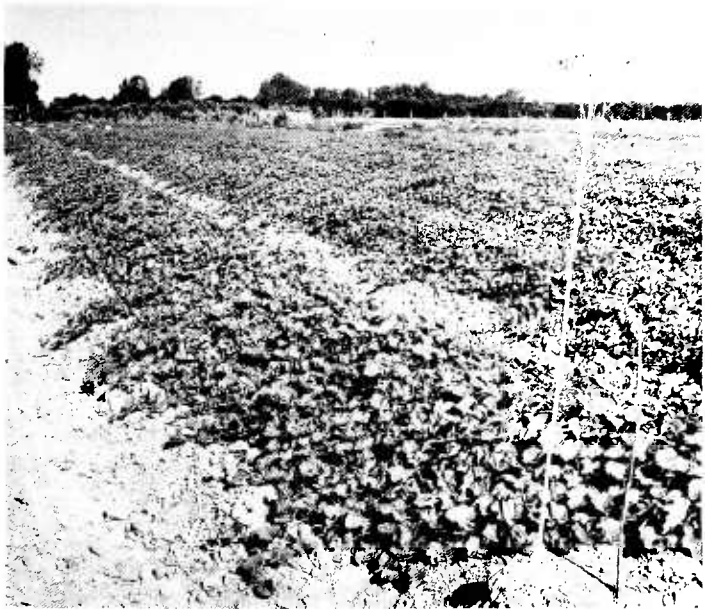

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FIGURE 8.—Muskmelon plants growing on raised beds between irrigation furrows.

FIELD SEEDING METHODS

Field methods of planting muskmelon seed vary according to locality and climate. In the East the seed is drilled in rows 5, 6, or 7 feet apart or planted in hills. In the drill method the seed is planted in a continuous row by machine planters. Later the plants are thinned so as to stand 2½ to 4 feet apart in the row. This method is commonly used in large plantings. It is more economical of labor than hill planting and gives a better distribution of the plants. In the hill method the hills are usually spaced 4 to 6 feet apart and checkrowed so that the field can be cultivated in both directions early in the season. The seed is planted by hand in groups of 8 to 10 seeds per hill. Spacing distances in either drill or hill planting depend on the muskmelon variety, the size of vine growth, and the cultivation equipment.

In the irrigated areas of California and Arizona the early crop is planted in single rows on the south side of a bed, with the centers spaced 5, 6, 7, or 8 feet apart (fig. 8). The row is placed just above the irrigation waterline. The seed usually is planted in hills spaced 18 to 24 inches apart, particularly where covers are used to protect the young plants. Later the plants are thinned to two in a hill. When covers are not used, the hills are spaced 9 to 12 inches apart and one plant is left in each hill. In districts where a later crop is grown and the plants grow larger than those of the early crop, the hills usually are spaced 4 to 5 feet apart in rows 5 to 8 feet apart.

Later the plants are thinned to two spaced well apart in the hill.

In the East, seed usually is planted with a single-row planter or in hills with a hoe. In the West, plantings are made with a hoe, with a hand corn planter fitted with a shoe to control the depth of planting, or with a tractor-drawn drill. This last method is rapid and distributes the seed evenly at a uniform depth in the soil. Drill planting is preferable where plants are not covered. It is wasteful of seed where covers are used, because many seedlings are not protected by covers and so are killed by the cold.

Plant muskmelon seed at depths of ½ to 1½ inches. The depth depends on the type of soil, its moisture content, and the variety of melon. Plant seed deeper in light sandy soil than in very moist soil or irrigated land. Seed of large-seeded varieties can be planted deeper than that of small-seeded ones. In the West, seed is planted deeper late in the season when the soil dries rapidly than in the winter and early spring when the soil is moist and cool.

HOTBED AND GREENHOUSE PLANTING

Hotbeds for starting muskmelon plants usually are 6 feet wide with standard 3- by 6-foot sash or plastic-film covers. Hotbeds are heated electrically or by flues running the length of the bed and connected with furnaces burning refuse wood, coal, or oil. Manure also is sometimes used for heating where more satisfactory methods are not possible. Since the plants are started only after the weather becomes moderate, not much artificial heating is required. Details of hotbed construction are given in Farmers' Bulletin 1743, Hotbeds and Coldframes. Plants may be grown in small sash greenhouses or larger conventional greenhouses.

Plant the seed about 3 to 4 weeks before taking the plants to the field. Plant in bands or in pots 3 to 5 inches in diameter. A good potting soil can be made from five parts of a fertile, friable loam mixed with two parts of sand and one of rotted manure. Plant six to eight seeds in each container and thin the seedlings to two to four plants. If clean soil is not available, the soil can be disinfected (p. 36). Treat the seed with a fungicide to protect against decay and preemergence damping-off (p. 23).

Growing muskmelon plants in hotbeds or greenhouses requires careful attention to temperature, watering, ventilating, and thinning. Maintain a temperature of 70° to 75° F. until the seeds germinate and then about 65° to 70° during the day and 60° to 65° at night. Provide plenty of ventilation to keep the plants short and stocky. When the plants are about ready to be set out, leave the beds uncovered most of the time to harden the plants to outdoor conditions. A greenhouse is not a good place to start melon plants unless it can be ventilated freely and high temperatures avoided.

Do not keep muskmelon plants in a hotbed or greenhouse longer than 4 or 5 weeks. The time for sowing the seed should be carefully determined with reference to the average date of the last spring frost for the locality. Nothing is to be gained by seeding too early, and it is much better to set out young and thrifty rather than overgrown or overaged plants.

A warm, calm day is best for transplanting in the field. Water the plants several hours beforehand and allow the foliage to dry. If the plants are in pots, knock the soil and root mass from the pot without breaking the soil and set carefully where the plants are to stand in the field.

USE OF PLANT COVERS

The maturity of muskmelon fruit is hastened by using paper covers to increase the soil and air temperatures about the seeds and young plants. In the southern inland valleys of California, seed for the early crop is planted from November 15 to February 15 and most of it prior to January 15. These plantings usually are protected with paper covers over the hills. The plants are then ready to blossom when the covers are removed in March. These plants mature their fruit 2 to 4 weeks earlier than unprotected plants. In the East, growers use covers to protect early plantings from cold winds and to warm the soil. Their use is especially profitable in short-season areas and where a very early crop is desired for market.

In California, covers are generally made from sheets of glassine paper, 18 by 20 inches, supported by an arch of wire or a bamboo strip, 20 to 24 inches long, with its ends inserted into the soil. Covers are placed over the arch as soon as the hill is planted, and soil is used to hold the paper in place. When the plants are thinned, the covers are opened slightly on the leeward side to provide ventilation. As the plants become larger, the covers are raised by lifting the ends of the supporting arch. When all danger of frost is past, the covers are removed. The paper lasts only one season, but the supports are serviceable for several years. Growers in the East often use similar covers and handle them in somewhat the same way.

Rigid paper covers of several types also are used. These are self-supporting and can be placed more rapidly than glassine sheets. The covers are made of glassine, plastic, and other transparent materials. When rigid covers are used, some provision must be made for ventilation on hot days, such as slitting the side away from prevailing winds. Some growers in the East tear out the top for ventilation and leave the sides for protection from the wind.

CARE OF GROWING PLANTS

CHEMICAL CONTROL OF WEEDS

Effective weed control is one of the most necessary and costly operations in the production of high-quality muskmelons. Herbicides help to reduce the cost of controlling many annual weeds prevalent in this crop.

Weeds that germinate and emerge simultaneously with the muskmelon plants can be controlled with a preemergence application of NPA (*N*–1–naphthylphthalamic acid). Use 2 to 3 pounds in 20 to 40 gallons of water per acre on light sandy soil, 3 to 4 pounds on loam, and 4 to 6 pounds on clay and muck. Apply the herbicide immediately after planting.

Weeds that germinate after vine growth prevents further close cultivation can be effectively controlled with an application of NPA, at the rates suggested above, 4 to 6 weeks after the muskmelon plants emerge. Remove established weeds by cultivation or handweeding before applying the herbicide, because it kills only germinating weeds. Successful use of NPA requires temperature and soil-moisture levels that will insure rapid germination of weed seed.

THINNING PLANTS

When seed is planted in the field, the plants require careful thinning. It is best to thin twice to allow for loss of small plants from insect

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injury or other causes. When one or two true leaves appear between the seed leaves, or cotyledons, thin the plants in widely spaced hills to about four in a hill. In closely spaced hills or drill plantings, leave only two plants. One or two weeks after the first thinning, thin the plants in the widely spaced hills to two widely spaced plants in the hill. In drill plantings growers usually thin to single plants 2½ to 4 feet apart in the row.

After hotbed or greenhouse plants are established in the field, thin them to two in a hill. Hills where less than two plants have survived may be replanted with extra ones grown for that purpose.

CULTIVATION

Cultivate muskmelons as soon as the rows of plants can be followed, and keep the soil free of weeds until the vines have spread too far to permit further working. Since the muskmelon is a rather shallow-rooted plant and its roots often extend farther horizontally than the vines, cultivation must be shallow, especially near the hills and after the vines begin to run freely.

When covers are temporarily removed for the first thinning of plants, cultivate the hills and the row between the hills with a hoe. As the plants develop, hand hoeing may be needed to remove weeds that cannot be destroyed by machine cultivation.

Where beds are used in the West, the top and the north side of the beds and the furrows are cultivated with small walking cultivators drawn by a tractor. Flat-land plantings throughout the country are cultivated with power equipment as soon as the plants appear. Checkrowed hills can be cross-cultivated for some time after vines begin to spread.

Power cultivators can be used near the row after the vines begin to spread if vine lifters are used on the cultivator or the vines are turned back by hand. At this time apply any second side dressing of fertilizer and work it into the soil. When lifting the vines, be careful not to damage the stems and leaves. Young fruit often is damaged if dragged over the soil, and badly shaped, unsalable melons may result. After the last cultivation, arrange the tips of the vines evenly so that their growth will cover the entire space between the rows.

PRUNING VINES AND THINNING FRUIT

Frequently growers ask whether they should prune muskmelon vines in order to increase the set of fruit or thin out excess fruit to hasten the development of fruit. Tests have shown that little if anything is to be gained by pruning muskmelon vines grown outdoors under ordinary conditions. Reducing the number of muskmelons on a vine will increase the size to which the remaining melons can grow. However, since vines of most muskmelon varieties produce some melons too large for a standard pack even without thinning, this operation may cause loss rather than gain.

POLLINATION

Inexperienced growers frequently ask why the earliest blossoms on their muskmelon vines do not set fruit. Muskmelon blossoms are of two kinds. The first to appear have only stamens, the pollen-bearing parts. Later come the flowers that bear pistils and produce fruit. Small, undeveloped melons form at the base of the pistillate blossoms even before the blossoms open. The melons can develop only if pollen is transferred to the pistils of these flowers. After a vine sets a few fruits, the demand is so heavy for nutrients necessary to mature them

that few later pistillate flowers will form.

Honey bees are the most effective pollinators of muskmelon blossoms. Fields well supplied with bees produce more fruit than those with fewer bees. In some locations it is necessary to provide a hive of bees for each acre of melons. The hives should be placed in the shade of trees or in some type of temporary shade.

IRRIGATION

Muskmelon vines require abundant moisture while making their most vigorous growth and until the melons are full grown. However, do not overwater just before and during the ripening period. Deep rooting and vigorous growth of the vines are possible only if the plants receive enough moisture, but the soil must not become too wet. Muskmelon roots may penetrate a deep, light-to-medium soil to a depth of 6 feet and spread 6 feet between the rows. In semiarid regions such soil should be wet to a depth of 6 feet after each irrigation. Muskmelon roots often do not penetrate to this depth in heavy textured soils, which should be wet only to the depth reached by the roots.

Light sandy soil and sandy loam do not hold as much moisture as the heavier silt and clay loams. Under normal conditions a sandy soil also loses moisture more rapidly than a heavier textured one. For these reasons a sandy soil needs more frequent irrigations and for shorter periods than silt or clay loams. Since the roots of large plants take up more moisture from the soil than those of small, young plants, more frequent irrigations are usually needed on any soil as the season advances.

In the early-crop districts of the West, the irrigations of the preceding crop usually leave the soil in condition for the next crop. To prepare for a summer crop, the fields are usually laid out to permit flood irrigation. The water is applied about 2 months before planting. After the soil is sufficiently dry, it is worked into beds. Water is run into the furrows between beds to wet the soil before planting. The beds then are allowed to dry until the moisture content of the soil is satisfactory for planting. In other sections there is no preplanting irrigation.

After planting in either moist or dry soil, the soil is irrigated to wet it a little above the planting line. No further water is needed until the plants blossom; they may be irrigated when covers are removed. When one or two fruits are set, a moderate amount of water is applied, and irrigations are continued at 2- to 3-week intervals up to harvest. During extended harvest periods light irrigations may be made to prevent wilting of the plants or excessive cracking of the soil.

In late-crop districts of the West and Southwest, muskmelons sometimes can be grown without irrigation if the soil is well moistened to the full depth of the root zone and the surface soil is moist at the time of planting. However, the yield of marketable melons often can be considerably increased by applying about 6 inches of water between emergence of the plants and harvest, even though the soil is at its field-capacity moisture content at the time of planting. In drier soils additional water is needed before or just after planting, and later applications are made when the plants tend to wilt during the day or cease to grow vigorously. Most of the late plantings are grown by flat culture, and the irrigation furrows are made at the last cultivation.

Muskmelon growers in the East are increasingly conscious of the value of irrigation. In dry seasons the yield of melons on light, sandy

soils can be greatly increased by irrigating with overhead sprinklers fed from a portable pipe. When no rain occurs, young plants should be irrigated every 10 to 12 days and every 5 to 7 days when the fruit is growing rapidly and ripening. Irrigations of as much as 1½ inches per acre may be needed on very light soils.

INSECT ENEMIES AND THEIR CONTROL

Profitable muskmelon production often depends on the control of insect pests. In the Southwestern United States the insect enemies of muskmelons include the beet leafhopper, leaf miners, the melon aphid, cucumber beetles, and spider mites. Information on these and other insects is given in the U.S. Department of Agriculture Leaflet 389, Cantaloup Insects in the Southwest: How To Control Them. In other parts of the country muskmelons are subject to damage by all these insects except the beet leafhopper, and they are controlled in the same manner as in the Southwest. However, in the Southeast late muskmelon crops often are attacked by the pickleworm. Information on this insect is given in the Department's Leaflet 455, The Pickleworm: How To Control It on Cucumber, Squash, Cantaloup, and Other Cucurbits.

BEET LEAFHOPPER

The beet leafhopper (*Circulifer tenellus* (Baker)) is a sucking insect about one-eighth inch long (fig. 9). It is gray to greenish yellow. It breeds on weeds in semiarid lands in the Western United States and is carried by winds to cultivated lands. Its only economic importance is that it carries the virus of curly top.

In melon fields it breeds on such weeds as sowbane, lambsquarters, and careless weed. Muskmelon plants are not their favorite food, and they do not reproduce on them. They soon leave a field if there are no weeds. If weeds are present, the leafhoppers hop back and forth between the weeds and the muskmelon plants.

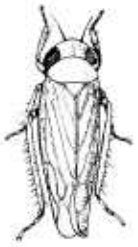

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FIGURE 9.—Beet leafhopper.

Clean culture is essential in beet leafhopper control. Weed the fields as early as possible to protect young plants, which are highly susceptible to curly top. When plants begin to send out runners, they will have developed considerable resistance to the disease.

If beet leafhoppers move into a field before you weed, blanket the entire field with a suitable insecticide dust or spray. Then weed immediately. Most of the leafhoppers are on weeds or resting on open ground.

LEAF MINERS

In the extreme southern United States tiny yellow maggots of small black and yellow flies eat irregular, winding, white tunnels in the melon leaves (fig. 10). They are known as leaf miners (*Liriomyza* spp.). They also attack such plants as peppers, tomatoes, sugar beets, and lettuce and may cause considerable damage. Leaf miners usually are

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FIGURE 10.—Muskmelon leaf severely damaged by leaf miners.

controlled by tiny wasplike parasites.

Insecticides should not be used unless needed, as they kill the parasites as well as the leaf miners.

MELON APHID

The melon aphid (*Aphis gossypii* Glover) is a small louselike insect (fig. 11). It obtains its food by sucking plant juices. It feeds on the underside of the leaves. Its presence often is first indicated by a slight curling or cupping of leaves. An infestation may start when a few winged females fly to melon plants, where they start colonies that may spread over the entire plant and throughout the field. In heavy infestations the leaves curl and lose color, and the affected plants die. These aphids spread the virus of mosaic disease from plant to plant.

CUCUMBER BEETLES

There are several kinds of cucumber beetles, and they vary in economic importance in different parts of the country. They are about three-sixteenths inch long and greenish yellow, with black stripes or spots. The striped cucumber beetle (*Acalymma vittata* (Fabricius)) has three longitudinal black stripes on the back (fig. 12). The spotted cucumber beetle (*Diabrotica undecimpunctata howardi* Barber) has black spots (fig. 13). The other species are similar in appearance. The striped cucumber beetle is most abundant east of the Rocky Mountains. The spotted cucumber beetle sometimes

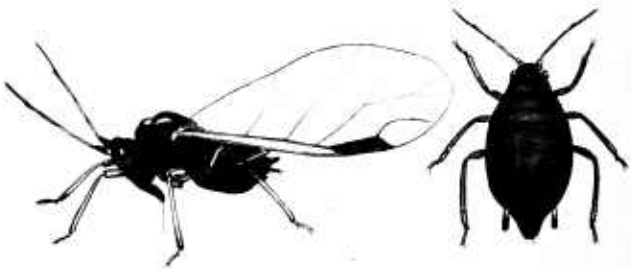

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FIGURE 11.—Winged and wingless adults of the melon aphid. (Greatly enlarged.)

is a menace to muskmelons in the same region. Both species occur in the South and Southwest.

In recent years the banded cucumber beetle (*Diabrotica balteata* LeConte) has become an important pest in the South and Southwest. It is sometimes more numerous than the other two species. The western striped cucumber beetle (*Acalymma trivittata* (Mannerheim)) and the western spotted cucumber beetle (*Diabrotica undecimpunctata undecimpunctata* Manner-

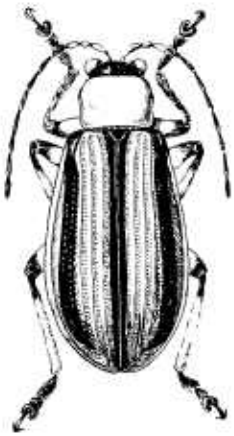

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FIGURE 12.—Striped cucumber beetle.

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FIGURE 13.—Spotted cucumber beetle.

heim) cause injury in the Rocky Mountain and Pacific Coast States.

Cucumber beetles frequently attack the plants as soon as they come up and they may kill them. As the plants grow, the beetles feed on the leaves, flowers, tender shoots, and fruit, and frequently spread bacterial wilt and mosaic disease. The larvae feed on the roots and underground part of the stalks.

SPIDER MITES

Spider mites (Tetranychidae) are so small that they are difficult to see with the naked eye, but their webbing is conspicuous when they become numerous. They injure the foliage by removing the chlorophyll, or green coloring, from the leaves and thus lower the quality of the melons. If injury to the foliage is severe, the melons will be exposed and sunburn damage will result.

PICKLEWORM AND MELONWORM

The pickleworm (*Diaphania nitidalis* (Stoll)) and its close relative the melonworm (*D. hyalinata* (Linnaeus)) are serious pests of muskmelons during the summer and fall in the Gulf and South Atlantic States. They frequently cause considerable damage in the States adjoining the Gulf and in the South Atlantic States and occasionally as far west as Oklahoma and Nebraska and as far north as Iowa and Connecticut. The insects feed on cucurbits throughout the winter in extreme southern Florida and Texas and gradually spread northward each year. Except in southern Florida and Texas, their injury to muskmelon is most serious during the summer and fall. Spring plantings escape damage in most areas in which the insects occur.

Young pickleworms are yellowish white, with numerous dark spots over the entire body. These spots disappear before the larvae are full grown. Young melonworms are greenish yellow, with two white lines that run the full length of the body. These lines disappear after the larvae are full grown. Mature pickleworms and melonworms are about three-fourths inch long.

The eggs of both insects are laid singly or in small clusters among the hairs on flower and leaf buds, small fruits, and young leaves. Young pickleworms feed on the surface, where the eggs are laid, but they soon tunnel into the flowers (fig. 14), terminal buds, stalks, vines, and fruits. Melonworms usually feed only on the foliage.

DISEASES AND THEIR CONTROL

Anyone growing muskmelons must guard against diseases that might seriously damage or even destroy the crop. The diseases most commonly causing muskmelon losses are damping-off, downy mildew, anthracnose, alternaria leaf blight, powdery mildew, fusarium wilt, bacterial wilt, mosaic, curly top, crown blight, and root knot. They can be prevented or greatly reduced by treating the seed with chemicals, planting seed on clean soil, and spraying or dusting the plants.

Certain fungicides used to control muskmelon diseases are marketed under various trade names,[4] as shown in table 1.

[4] Trade names are used in this publication only to provide specific information. Their use does not constitute a guarantee of the products named and does not signify that they are approved by the U.S. Department of Agriculture to the exclusion of others of suitable composition.

TABLE 1.—*Common, chemical, and trade names of various fungicides used to control muskmelon diseases*

Common name	Chemical name	Trade name
Captan	N-trichloromethylthiotetrahydrophthalimide.	Orthocide 50 Wettable, Orthocide 75 Seed Protectant, Stauffer Captan 50-W, Stauffer Captan 75 Seed Protectant.
Nabam	Disodium ethylene bisdithiocarbamate	Chem-Bam, Dithane D-14, Niagara Nabam Solution, Ortho Nabam Spray, Parzate Liquid Fungicide.
Thiram	Tetramethylthiuram disulfide	Arasan 75, Arasan SF-X, Chipman Thiram SF 75, Roberts Thiram, Thiram 75 W.
Zineb	Zinc ethylene bisdithiocarbamate	Dithane Z-78, Ortho Zineb 65 Wettable, Parzate C Zineb Fungicide, Parzate Zineb Fungicide.
Ziram	Zinc dimethyl dithiocarbamate	Karbam White, Niagara Z-C Spray, Orchard Brand Ziram, Ortho Ziram 76 Fungicide, Zerlate Ziram Fungicide, Zirberk.

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FIGURE 14.—Pickleworms feeding in squash flower.

Caution: Chemicals used as fungicides and soil fumigants are injurious to man and animals if taken internally; some are very poisonous. Avoid getting them into the mouth, eyes, or nose. When used in dusts, avoid inhaling them. Wear a respirator or mask when dusting plants in the field or large quantities of seed. Such protection is not needed in treating small quantities of seed in the open air or in a well-ventilated room. Pour out any unused chemical spray solution. It should sink into the ground and not stand in puddles. Thoroughly clean all equipment used for such sprays. Plainly label all containers of chemicals. Keep them out of reach of children, pets, and livestock.

DAMPING-OFF

Description.—Damping-off, a disease of muskmelon seedlings, is caused by various fungi, most commonly by *Rhizoctonia solani* Kuehn and species of *Pythium*, which may be present in any agricultural soil. Usually they cause most serious losses during long periods of wet weather. The most common type of damping-off is a shriveling of the stem at the ground line that leads to quick collapse and death of the seedling. The fungi that cause this also cause decay of seed in the ground, and they kill seedlings before they emerge from the soil. Often when a farmer gets a poor stand of muskmelons and thinks that the seed he planted must have been inferior, these preemergence forms of damping-off are the real cause of the trouble.

Recommendations for Control.—Seed decay and killing of seedlings before they emerge from the soil usually can be prevented by dusting the seed with certain fungicides, such as thiram, captan, and Semesan (hydroxymercurichlorophenol). Apply them at the rates recommended by the manufacturers. When seed is to be treated, pour it into a dusttight jar or other container until the container is about half full, add the fungicide dust, cover the container tightly, and shake for 1 to 2 minutes. Screen off excess dust, and the seed is ready to plant.

Where plants are started in seedbeds, damping-off can be checked by spraying the soil immediately after planting with a suspension of 2 pounds of captan in 100 gallons of water. Apply it at the rate of 1 gallon to each 125 square feet of bed.

DOWNY MILDEW

Description.—Downy mildew is one of the most common and most destructive diseases of muskmelons and cucumbers in the Atlantic and Gulf Coast States. At times it causes some damage to watermelons, squash, and pumpkins. It

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FIGURE 15.—Muskmelon leaf spotted and yellowed by downy mildew.

has been reported in most of the States where these crops are commonly grown, but it is usually not very important economically in other regions.

This disease, which is caused by the fungus *Pseudoperonospora cubensis* (Berk. & Curt.) Rostow., usually appears when the vines are beginning to set fruit. It spreads very rapidly in warm, moist weather. The first symptoms are small, yellowish spots, not sharply outlined, on the leaves. Leaf tissue at the center of each spot soon turns brown and dies (fig. 15). The yellowed area enlarges considerably. When the spots become numerous, the leaf shrivels and dies. The withered leaves curl upward at the edges, a characteristic by which downy mildew can be identified. The oldest leaves die first, and finally only the young leaves at the tips of the runners remain alive. The fruit is not attacked, but that ripening on vines that have lost many leaves is flat and of very poor flavor.

The fungus causing downy mildew produces spores on the underside of leaves during moist weather. These spores are spread to other leaves by rain and by handling the plants and also can be carried considerable distances by wind. Periods of hot, dry weather tend to check the spread of the fungus, but after it appears in a field, it is likely to spread rather rapidly unless efforts have been made to control it.

The fungus is not carried on the seed and apparently cannot overwinter in the soil. However, in Florida it lives on some of its host

plants throughout the year. Because the fungus spores can be carried by wind, the disease gradually moves northward during the spring and summer, and by early August it often appears in the North Atlantic States. The U.S. Department of Agriculture, with the cooperation of the agricultural experiment stations of the States along the Atlantic seaboard, maintains a downy mildew warning service. The Department receives weekly reports on outbreaks and spread of the disease and issues summarized reports so that State officials can tell growers when the disease is likely to appear in their localities.

Recommendations for Control.—Downy mildew is not easy to control, but losses from this disease can be greatly reduced by efficient application of sprays or dusts. Zineb (p. 39) is effective against downy mildew and is extensively used for its control. The fixed copper compounds (p. 38) also are effective and are frequently used. However, they are not satisfactory for the control of anthracnose (p. 26) and may occasionally cause some injury to muskmelon plants in the blossoming stage. Nabam when used with zinc sulfate gives a compound closely similar to zineb and is used in a spray to control downy mildew. A mixture of 2 pounds of zineb and 4 pounds of a 50-percent fixed copper compound in 100 gallons of water also seems very effective against downy mildew on muskmelons. Methods of applying these fungicides are discussed under Spraying and Dusting (p. 37).

Apply fungicides whenever infection threatens and repeat at 7-day intervals throughout harvest if rainfall is normal. If long periods of dry weather occur, applications every 10 days may be sufficient.

The varieties Rio Gold, Rio Sweet, Texas 1, Georgia 47, Smith Perfect, Edisto, and Homegarden are resistant but not immune to downy mildew.

ANTHRACNOSE

Description.—Anthracnose, caused by the fungus *Colletotrichum lagenarium* (Pass.) Ell. & Halst., is a common damaging leaf spot disease of muskmelons, cucumbers, and watermelons in the Central, Eastern, and Southern States. This fungus attacks leaves, stems, and fruit.

On muskmelon leaves the first symptom is small, yellowish, water-soaked spots, irregular in shape, which often occur along the veins of the leaf. These spots enlarge to form reddish-brown dead patches one-fourth to three-eighths inch wide. Often such patches split or are beaten out by rain, and the leaves appear ragged.

On the stems and petioles appear long, dark, sunken spots, which may girdle the petioles and young runners. This injury may be severe enough to defoliate the plant within a rather short time.

Infected fruit has dark, sharply sunken, circular spots about one-half to three-quarters inch in diameter (fig. 16). In warm, moist weather the centers of the spots have pinkish masses of spores. Spores are produced less abundantly on leaves and stems. Spotted fruit is usually unsalable, and fruit from vines with badly spotted foliage is likely to be of poor quality.

The fungus causing anthracnose is carried on the seed and may live for 1 or 2 years in the soil. Probably the seed is often the source of the first infection that appears in a field. Later, spores produced on diseased plants are splashed to nearby plants by rain, carried by surface drainage water to plants in other parts of the field, and spread also by cultivating or handling plants when they are wet with rain or dew.

FIGURE 16.—Muskmelon plant affected by anthracnose. The fungus has killed the leaves and spotted the fruit.

Recommendations for Control.—To control anthracnose successfully, rotate crops and disinfect seed. Do not grow muskmelons in any field where they were grown the preceding year, and do not use a field for a cucurbit crop oftener than once in 3 years.

To treat muskmelon seed for planting, pour it into a bag of loosely woven fabric until the bag is half full, then soak for 5 minutes in a 1–1,000 solution of bichloride of mercury (corrosive sublimate), rinse for 10 minutes in running water or several changes of water, and then dry. Bichloride of mercury can be bought in most localities in the form of blue 7½-grain tablets. This size tablet is convenient for treating small quantities of seed, since one tablet dissolved in a pint of water gives a 1–1,000 solution. In making larger quantities of the solution, dissolve 1 ounce of powdered bichloride of mercury in 7½ gallons of hot water. Do not use the solution more than twice, as it loses strength with continued use. Prepare it only in glass, enamel, or earthenware containers, for the chemical corrodes metal containers.

This treatment effectively disinfects the surface of the seed but does not kill the fungus if it has penetrated within the seed. Therefore, it may not give complete protection against seed transmission of the fungus. This treatment does not protect against damping-off. If this protection is desired, treat the seed as described on page 23.

Caution: Bichloride of mercury is a deadly poison. For precautions, see page 23.

Seed treatment and crop rotation can be very effective in keeping muskmelon fields free from anthracnose. However, at times the disease appears despite these precautions, and fungicides must be used to control it. Ziram (p. 39) is effective against anthracnose, and captan (p. 38) also is used with good results. Ziram and captan do not seem to control downy mildew as satisfactorily as do zineb (p. 39) and the fixed copper compounds (p. 38).

Where downy mildew is prevalent, its control is of major economic importance and usually must be considered first in choosing a fungicide for potential control of anthracnose. Zineb is effective against this disease and gives good control of downy mildew. Nabam plus zinc sulfate (p. 39) gives fair control of anthracnose and is effective against downy mildew. Fixed copper compounds (p. 38) give good control of downy mildew but are not very effective against anthracnose. Where the use of a fixed copper compound seems advisable for control of downy mildew, spraying with a mixture of 1 pound of ziram and 2 pounds of a 50-percent fixed copper compound in 100 gallons of water should give fairly effective control of both downy mildew and anthracnose. Methods of applying these fungicides are discussed under Spraying and Dusting (p. 37).

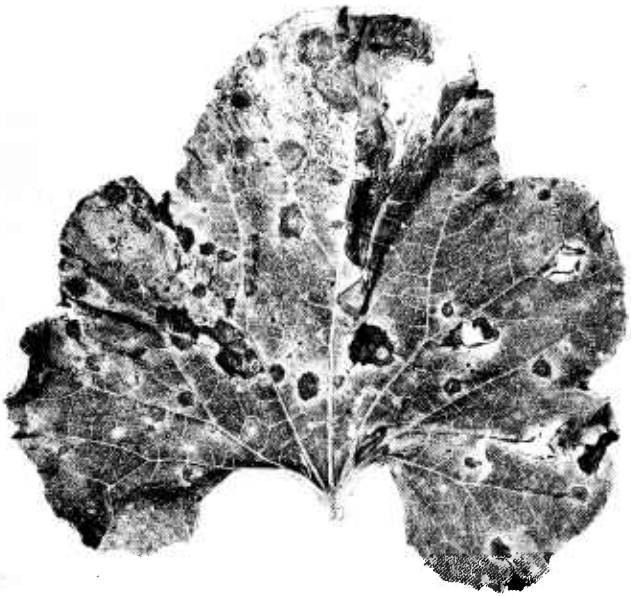

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FIGURE 17.—Muskmelon leaf affected with alternaria leaf blight. The spots are brown; some have concentric ring markings.

ALTERNARIA LEAF BLIGHT

Description.—Alternaria leaf blight, sometimes known as rust, is a common disease of muskmelons. It is caused by the fungus *Alternaria cucumerina* (Ell. & Ev.) J. A. Elliott (synonym, *Macrosporium cucumerinum* Ell. & Ev.), which also causes a less severe leaf spot of cucumbers, squash, and watermelons. The disease frequently causes considerable muskmelon losses from defoliation.

The first symptoms usually appear in midseason on the older leaves. At first the affected leaves show very small, round, water-soaked spots. These spots enlarge rapidly until their diameters range from one-eighth to one-half inch (fig. 17) and may show concentric ring markings. They gradually turn brown. Often several spots merge, forming a dead area of considerable size. In warm, moist weather the disease spreads rather rapidly and may kill much of the foliage; thus the fruit is exposed to sunscald injury. Overripe fruit of severely diseased vines sometimes has a few small, sunken spots.

Recommendations for Control.—A 3-year rotation as recommended for anthracnose (p. 26) helps prevent outbreaks of alternaria leaf blight. Spraying or dusting with zineb (p. 39), ziram (p. 39), nabam plus zinc sulfate (p. 39), or captan (p. 38) is recommended. The mixture of ziram and a fixed copper compound used to control anthracnose appears to reduce loss from alternaria leaf blight. The varieties

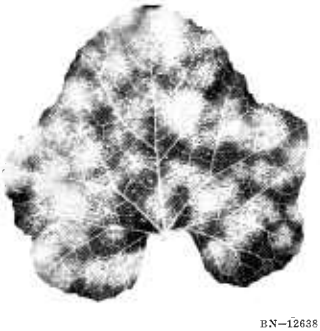

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FIGURE 18.—Muskmelon leaf, showing grayish-white fungus growth characteristic of powdery mildew.

Purdue 44, Edisto, Georgia 47, and Smith Perfect have moderate resistance to this disease.

POWDERY MILDEW

Description.—Powdery mildew affects muskmelons, cucumbers, squash, and pumpkins and may occur wherever these crops are grown. It has caused severe losses in the large muskmelon-producing sections in the Southwestern States and at times is damaging to muskmelons in some of the South Atlantic States. The disease is caused by the fungus *Erisyphe cichoracearum* DC., which has race 1 and race 2. These races produce the same symptoms, but muskmelon varieties resistant to race 1 may not be resistant to race 2.

The fungus grows on the surface of the leaves and of the stems and absorbs its nourishment by means of minute organs, or haustoria, which penetrate the epidermal cells of the host plant. The first symptom of the disease is small, white patches on the underside of the older leaves and on shaded parts of the stem near the soil. The spots soon appear on both surfaces of the leaves and enlarge until the older leaves and stems are covered with the white, powdery growth of the fungus (fig. 18). In cool, moist weather infected leaves remain alive for some weeks. However, in hot, dry weather they soon wilt, die, and become brown and brittle.

The killing of the leaves weakens the plants and exposes the large fruit to the sun. Many of the melons become sunburned and the others are usually of poor flavor and texture. Fruit produced after infection may be small and misshapen. The reduction in yield is proportionate to the earliness and severity of disease development.

Recommendations for Control.—In the Southwestern States powdery mildew can be controlled by using resistant varieties. Powdery Mildew-Resistant Cantaloup No. 5 and PMRC No. 6 are resistant to both race 1 and race 2 of the fungus. Where race 2 is not prevalent, PMRC No. 45 and PMRC No. 450 can be grown successfully. These varieties have been developed for use in the Southwest, but PMRC No. 45 may be of value where the disease is damaging in the Southeastern States. The varieties Homegarden, Edisto, and Georgia 47 have moderate resistance to powdery mildew.

Powdery mildew can be effectively controlled with sulfur dusts. However, the Southwestern States, where this disease is severe, have very high temperatures during much of the growing season, and at such temperatures sulfur dusts severely injure most kinds of muskmelons. Honey Dew and Honey Ball melons tolerate sulfur, and the varieties V–1 and SR No. 91 have been developed for sulfur resistance. However, in extremely hot weather even these varieties may be injured by sulfur dusts. Do not dust PMRC Nos. 5, 6, 45, and 450 with sulfur.

Losses from powdery mildew can be reduced by spraying with Kara-

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FIGURE 19.—Muskmelon plant affected with fusarium wilt. Some leaves are brown and withered, and some of the stems have a brown discoloration and fungus growth.

thane WD (dinitro capryl phenyl crotonate) at the rate recommended by the manufacturer.

Caution: Do not apply Karathane to muskmelons within 7 days of harvest.

FUSARIUM WILT

Description.—Fusarium wilt of muskmelons, caused by the fungus *Fusarium oxysporum* Schlecht. f. *melonis* (Leach & Currence) Snyder & Hansen, has resulted in losses in some sections of the Central and Eastern States. The fungus lives in the soil and enters the plant through the roots. On very young plants grown in badly infested soil, it may cause root rot or wilting of the seedling with little external evidence of stem injury. On older plants the first symptom is a wilting of one or more runners (fig. 19). The leaves of the wilting shoots turn brown, and brown, dead streaks commonly develop on the stems near the ground line. These streaks may extend some distance, and in moist weather they often have salmon-pink masses of fungus spores. Eventually all parts of the plant wilt and it dies.

Recommendations for Control.—The fungus causing fusarium wilt can live for a long time in the soil. Do not grow muskmelons on land known to be heavily infested with it. Avoid carrying fungus-infested soil to clean fields on cultivators or other farm equipment. Since the fungus enters the plant through the roots, spraying will not control the disease. Most of the standard muskmelon varieties are susceptible to fusarium wilt, but some resistant varieties have been developed. Those most generally used are

BN–12633

FIGURE 20.—Muskmelon plant severely affected with bacterial wilt. The leaves droop and wither but remain green.

Iroquois, Delicious 51, Honey Rock Fusarium Resistant, Spartan Rock, and Harvest Queen.

BACTERIAL WILT

Description.—Bacterial wilt, caused by *Erwinia tracheiphila* (E. F. Sm.) Holland, is a common disease of muskmelons, cucumbers, and squash in the North Central, Middle Atlantic, and North Atlantic States, where sometimes serious losses occur in individual fields. This disease causes some losses in the Southeastern States, but it is less prevalent. It is not prevalent on muskmelons in the Southwestern States.

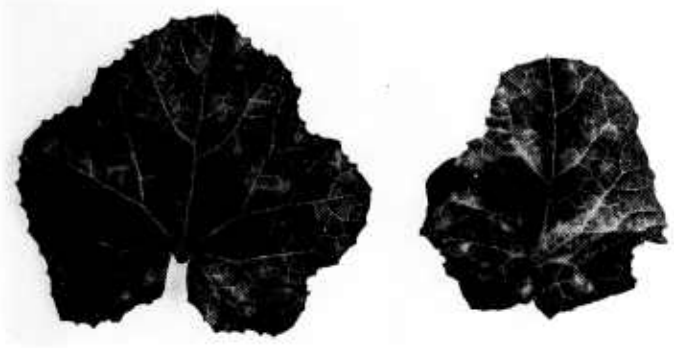
Infected plants first show a drooping of a few leaves, which remain green. The wilting gradually extends to leaves on other runners (fig. 20). The bacteria produce this wilting by working downward into the water-conducting vessels of the stem and causing them to become clogged. Eventually they kill the plant. The bacteria are spread by the cucumber beetles, which carry them from diseased to healthy leaves on their mouth parts and transmit them in feeding. The bacteria do not live in the soil or in the seed, but they are carried over winter by these beetles.

Recommendations for Control.—For most effective control, use insecticides [5] early in the season to reduce the number of cucumber beetles in the field. In small plantings remove and destroy wilted plants infected with this disease.

MOSAIC

Description.—Mosaic is a widespread and serious disease of muskmelons. It can be caused by several viruses, most of which are commonly spread by aphids. The squash mosaic virus is spread only by certain species of cucumber beetles. All these insects carry the virus from diseased to healthy plants in feeding. The viruses also

[5] See U.S. Dept. Agr. Leaflet 389, Cantaloup Insects in the Southwest: How To Control Them.



BN—12630

FIGURE 21.—Young leaves of a muskmelon plant, showing the characteristic yellowish-green mottling caused by the common cucumber mosaic virus.

are transmitted by handling diseased and then healthy plants or by any other means by which a very small quantity of juice from an infected plant is brought into contact with a slight wound in a healthy plant. The viruses causing muskmelon mosaic also attack such cucurbits as cucumbers, squash, and watermelons, and one of them causes considerable loss of pepper and celery. These viruses infect several perennial and annual weeds.

In the Eastern and North Central States the most common form of muskmelon mosaic is caused by the ordinary cucumber mosaic virus. Leaves of mosaic-affected muskmelon plants are mottled with light green (fig. 21) and are often slightly dwarfed and curled, but usually the plants grow to almost normal size. The young fruit is sometimes mottled, and the size and number of the fruit are often reduced. Fruit from severely diseased vines is usually of poor quality.

This virus is not known to be carried in muskmelon seed and does not overwinter in the soil. However, it does overwinter in the roots of certain perennial weeds, such as milkweed, groundcherry, and catnip, and it is carried in the seed of the common wild cucumber. Aphids feeding on these plants carry the virus to muskmelon fields.

In the Southwestern States mosaic causes serious losses. The watermelon mosaic virus is most prevalent, but the cucumber mosaic virus also is common. They often occur in the same muskmelon plant. The squash mosaic virus also is found in the Southwest, but it seems to be comparatively rare in the desert areas where the early crops are grown. The watermelon mosaic virus, like the cucumber mosaic virus, is transmitted by aphids, and rarely, if ever, is carried in the seed. The squash mosaic virus is transmitted by cucumber beetles. The comparative rarity of these insects in muskmelon fields of the Southwest probably accounts for its being less prevalent than the viruses spread by aphids. The squash mosaic virus is carried in a small percentage of the seed of fruit from mosaic-affected muskmelon and squash plants.

Watermelon mosaic virus affects squash and pumpkins. It is also found on several cultivated and wild species of plants outside the

family Cucurbitaceae. Some of these, such as cheeseweed, sour clover, and possibly alfalfa, may be of economic importance as sources of primary infection to muskmelons in the Southwest. The relative prevalence of the watermelon and cucumber mosaic viruses in this region, when no other cucurbit crops are present, seems to depend on the comparative abundance of noncucurbit hosts of the respective viruses.

In the Southwest the symptoms of muskmelon mosaic vary with the virus or combination of viruses with which the plant is infected. Symptoms of cucumber mosaic virus alone are usually of the same type as described on page 31. Where watermelon mosaic virus is present, alone or in combination with the cucumber mosaic virus, there may be much more severe injury to the plants. The leaves are mottled with light-green or yellow-green areas of irregular outline, and some of the veins may be killed. Leaves commonly are much stunted and often deformed. The tips of some runners frequently are yellowed and stunted. When plants are severely affected, the stem continues to grow, but only aborted leaves are produced. This "leafless" condition of the stem is characteristic of mosaic on muskmelon plants in the Imperial Valley.

Flowers may appear normal, unless closely examined, and they produce no fruit. Fruit that is set is small, mottled, and malformed. Fruit not visibly affected by the virus often is of poor quality, and the netting is poor on that of the "cantaloup" varieties. Losses are severe if plants are infected when small, but slight if infection does not occur until shortly before harvest.

In central and northern California there is evidence that muskmelons are most commonly affected by the cucumber and squash mosaic viruses. Watermelon mosaic virus appears to be much less prevalent than in the Southwestern States.

Recommendations for Control.—No effective control measures have been developed for muskmelon mosaic. Muskmelons should not be grown near squash, cucumbers, watermelons, or peppers. In the Eastern and North Central States destroying perennial weeds near the muskmelon field has sometimes given good results; in the arid sections of the Southwest control is more difficult. Insect control is necessary, but it cannot be depended on to prevent spread of the virus. Seedborne viruses can be controlled, provided there are no other sources of infection, by using virus-free seed or by carefully removing infected plants at the time of thinning. This must be done by workers who are familiar with mosaic symptoms and are careful not to transmit the virus by also handling healthy plants.

No mosaic-resistant muskmelon varieties are available. The Honey Dew and Honey Ball melons are more severely affected than most of the so-called "cantaloup" varieties. In the Southwest, losses from mosaic can be considerably reduced by cultural methods that promote and maintain vigorous growth.

CURLY TOP

Description.—Muskmelons, like tomatoes, beans, peppers, spinach, and certain other vegetable crops, are susceptible to the curly top virus. This virus, which takes its name from the disease it produces on sugar beets, also affects several weeds and some ornamentals. The disease is common in commercial muskmelon plantings in Arizona and California. In those areas of central Washington, eastern Oregon, and southern Idaho where curly top is prevalent every year,

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FIGURE 22.—Part of a muskmelon plant affected with curly top. Note that the distance between the leaves is shortened at the end of the runner.

the disease limits muskmelon production.

The virus is not transmitted through the seed or soil. The only known means of its dissemination is the beet leafhopper. Therefore, the geographical distribution of the disease is limited to the range of this insect, which may be carried long distances with the prevailing winds. The leafhopper breeds in weedy, abandoned lands and sagebrush areas west of the Continental Divide and in areas of southern New Mexico and western Texas. Until recently curly top had not been reported east of the Mississippi River, but the disease is known to have occurred occasionally in the Central and Eastern States.

The severity of curly top on muskmelons varies with the age of the plant at the time it is infected. Seedlings infected in the cotyledon stage usually die. Many of the plants with two to four leaves at the time of infection are killed or so badly stunted that they are valueless. The leaves are reduced in size and bunched together because of the shortening of the distance between the leaves on the stem. Plants infected in the six-leaf stage or thereafter may show no evidence of the disease, but occasional plants show a bunching of the leaves at the tip of the runners (fig. 22). Even when plants show no symptoms, the yield may be appreciably reduced.

During the spring and summer the spring broods of mature leafhoppers move to cultivated areas,

where they feed on sugar beets, other cultivated crops, or weed hosts. Many of the migrating insects carry the virus and transmit it to any susceptible plants on which they feed during the spring. These hosts serve as sources of the virus to later broods of leafhoppers, which develop on favored crops and weed hosts in or near the cultivated fields.

The prevalence of curly top in any given season depends on the number of the insects carrying the virus, the virulence of the strains of the virus they carry, and the stage of development of the crop plants when the insects appear in the field.

Recommendations for Control.—No very satisfactory method has been developed to control curly top on muskmelons. Certain insecticidal sprays and dusts will kill the leafhopper and may help to reduce spread and loss from curly top.

Certain sanitary measures will help to reduce the number of leafhoppers feeding on muskmelons. Weed-free fields are necessary to protect muskmelons from the leafhopper. Clean culture at the beginning of the season removes the weeds that are favored hosts of the insect and reduces the number of insects when the plants are small and most severely damaged by curly top. If the leafhoppers migrate to the fields before they are weeded, spray or dust the entire field at once with a suitable insecticide [6] and then destroy all weeds. There are no muskmelon varieties with marked resistance to curly top.

CROWN BLIGHT

Description.—Muskmelon crops in the desert areas of California and Arizona are severely damaged by crown blight, a disease of unknown cause. It seems to be limited to muskmelons planted in desert areas in the winter and harvested during the spring. It has not been observed in other areas where muskmelons are planted in the late spring or in the summer and harvested during the late summer and early fall. This also is generally true of muskmelons planted in the summer in areas where the disease damages the winter-planted crops.

The characteristics and intensity of crown blight symptoms may vary with the locality and the cultural practices in individual fields. The first symptoms usually appear some time after the plants have set fruit, and the injury becomes increasingly severe as the fruit approaches maturity and continues to ripen. Mature leaves at the base of the stem develop one or more V-shaped dead sectors, which extend inward from the leaf margin and are centered on the large veins. These areas become dry and brittle. Other leaves may be yellow at the margins or entirely yellow. Parts of the leaves with V-shaped dead areas and the leaves adjacent to them may become bronze. Leaf petioles may be streaked with brown. In some fields the petioles are yellow and translucent. The affected leaves and their petioles soon become brown, dry, and brittle, but they remain attached to the stem.

Leaves die in succession along the runners, but sometimes alternate leaves die and the others remain apparently normal. Eventually all the leaves on most of the runners die, but those at the tip usually last longer than those that are more mature. The death of the "crown" leaves of severely affected plants destroys the leaf cover of the maturing melons, and the fruit usually becomes sunburned and unmarketable (fig. 23).

The appearance of crown blight on the foliage is commonly accompanied by decay of the smallest roots. This reduction in the root system may be a factor in the premature death of the foliage during

[6] See footnote 5, p. 30.

the high temperature and low humidity that prevail at harvesttime where the disease occurs.

Crown blight may be caused by a combination of factors. However, extensive investigations have seemingly eliminated a number of suggested causes. Applications of fungicides have little effect on the severity of the disease in the absence of powdery mildew. Soil salinity does not seem to cause it. Neither excessive nor deficient nitrogen, phosphorus, or trace elements have been proved to cause it, although fertilizer practices may affect the severity of the disorder. Irrigation practices can affect its severity, but they do not seem to cause it. Leaf miner injury can cause a severe "blight" of crown leaves of muskmelons and is often confused with crown blight.

The severity of crown blight appears to be increased by high soil and air temperatures, by the smallness and number of living roots, by a heavy fruit load on the plants, and by the prevalence of certain root-rotting fungi in the soil. Infection of the plants with mosaic viruses also appears to be a possible factor in the cause of crown blight.

Recommendations for Control.—No specific recommendations can be made for the control of crown blight. Drought, insects, powdery mildew, mosaic viruses, and root-rotting fungi all may be factors in its development.

Drought can be controlled by proper irrigation. Good cultural practices seem to delay the injury from crown blight. Powdery mildew can be controlled by using resistant varieties or applying Karathane (p. 28). Breeding for resistance to mosaic and crown blight is in progress, and mosaic-resistant varieties may become available for the Southwest. Powdery Mildew-Resistant Cantaloup 88 is a Honey Ball type with moderate resistance to crown blight.

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FIGURE 23.—Muskmelon plants affected with crown blight. Older leaves have died and others are yellow at the margins. Recently exposed fruit is only faintly netted but not yet sunburned.

Arizona Sunrise is a "cantaloup" type that tends to escape crown blight because of its early maturity, but it is not resistant to powdery mildew.

ROOT KNOT

Description.—Root knot of muskmelons and of many other plants is caused by very small eelworms or nematodes (*Meloidogyne* spp.). Aboveground symptoms of root knot are lack of vigor, dwarfing of the plants, and a tendency to wilt during the heat of the day. When these symptoms are seen, some plants should be dug up and the roots examined. If attacked by nematodes, the roots will have distinct knots or galls ranging in size from about one-sixteenth of an inch in diameter on the very small roots and resembling beads on a string to one-half inch or more in diameter on older roots. Plants heavily infected with root knot produce a few small muskmelons, but some plants may die before producing any fruit.

The nematodes that cause root knot attack a great variety of crops.

When a crop has been infected, nematodes will remain in the soil after it is harvested and attack the next crop. To avoid planting on land where root knot occurs, it is a good practice to examine the roots of the previous crop. If root-knot galls are found, use another field or fumigate the soil, as described below, before planting. There is no cure for root knot on muskmelons after planting.

Recommendations for Control.— Nematocides, or soil fumigants, are chemicals used to control root knot. Three kinds are available for use in muskmelon fields. Their active ingredients are dichloropropene, ethylene dibromide, and dibromochloropropane.

For muskmelons, apply these nematocides by the "row treatment" method. First plainly mark the rows by scratching a shallow furrow or by building a low ridge. Then place the nematocide directly under the row at a depth of about 8 inches. Use the amount recommended by the manufacturer. Good results can be expected only if the nematocide is placed at the proper depth, regardless of whether it is a liquid, emulsifiable, or granular formulation. Applications are quickly and easily made by using special applicators sold for the purpose or by various kinds of improvised equipment. Apply nematocides at least 2 weeks before planting and when the soil is moist but not too wet to work well. Be sure to plant the seed directly over the nematocide.

When using nematocides, follow the manufacturers' directions exactly and also consult your local county agent or State agricultural experiment station as to the most efficient application methods and possible deleterious effects under local conditions. This precaution is necessary because variations in soil and climate may affect the action of the nematocides.

As of March 1961, nematocides containing dichloropropenes are registered by the U.S. Department of Agriculture under the Federal Insecticide, Fungicide, and Rodenticide Act and the Miller Amendment of the Federal Food, Drug, and Cosmetic Act for use on soil to be planted to muskmelon. This registration is on the basis that no residue will result from using preplanting applications of 120 to 202 pounds of actual dichloropropene per acre on ordinary soils or 320 to 486 pounds per acre on muck-type soils, and that muskmelons will not be planted until 2 to 3 weeks after soil treatment or until the odor of the chemical has left the soil.

When nematocides containing ethylene dibromide or dibromochloropropane are used for soil treatment, there is a tolerance of 75 parts per million of inorganic bromide calculated as bromine. Further information will be found on the container label or can be obtained from your county agent or the manufacturer's representative.

Caution: Handle nematocides with extreme care. Avoid prolonged breathing of the fumes, and do not allow the liquid to come into contact with the skin. If the liquid is accidentally splashed on the clothing, including shoes or gloves, remove the clothing at once and wash, clean, or thoroughly air it for a day or two. Keep nematocides away from the mouth and eyes. If they are splashed into the eyes, wash out with large quantities of water and consult a physician.

Root knot can also be controlled by growing crops that are not attacked by the root-knot nematodes for at least 2 years between muskmelon crops. In general, small grains, hairy indigo, several kinds of crotalaria, or peanuts can be used as rotation crops. Since the kinds of root-knot nematodes vary in

different parts of the country, check with your county agent or the State agricultural experiment station before starting a rotation.

SPRAYING AND DUSTING

Muskmelon losses from downy mildew, anthracnose, powdery mildew, and alternaria leaf blight can be much reduced by efficiently applying the most effective fungicides. However, fungicides can only protect plants from infection; they cannot cure diseased plants. These four diseases can be controlled satisfactorily, provided spraying or dusting with a suitable fungicide is started before the disease organism has become established in the field and provided the spray or dust thoroughly coats the plants.

Spraying is usually more effective than dusting, because the spray adheres better to the foliage. Spraying is increasing as a general practice in muskmelon production.

When To Apply Fungicides

Spraying or dusting can be done most economically and effectively if the first application of a fungicide and the intervals between the later ones are determined somewhat by the amount of rainfall. Ordinarily the first application need not be made until 6 to 8 weeks after planting, when the vines have spread well out into the rows. However, where anthracnose is prevalent, an early appearance of this disease may make it necessary to spray or dust the plants when they are rather small. If very rainy weather occurs early in the growing season, it often is advisable to start spraying or dusting earlier than is normally necessary. During humid weather fungicides can be profitably applied at 7-day intervals, but frequently a 10-day interval is sufficient for adequate protection. Spraying or dusting should continue until a week before harvest, especially in areas where downy mildew is prevalent.

How To Apply Fungicides

In spraying or dusting muskmelons it is essential to have efficient power machinery to insure good coverage of the leaves with the fungicide. The rows must be so spaced as to permit passage of the sprayer or duster.

Muskmelons commonly are sprayed with standard fixed-boom hydraulic sprayers. The fungicide formulations usually are applied at the rate of 150 gallons per acre at a pressure of about 300 pounds per square inch (p.s.i.). This type of application is effective if sufficient nozzles are used per melon row and are so arranged that both surfaces of the leaves are covered with the fungicide.

One method of application that has given good results consists of using six nozzles per melon row arranged so as to whirl the spray. This is done by directing one of the end nozzles forward and the other back at a slight angle to the plants. This arrangement gives a slight "twist" to the leaves. The four top nozzles are arranged so that two point slightly forward and two slightly backward. Thus the forward-angled nozzles cover the lower surface of the leaves and those angled backward cover the upper surface.

When spraying with fixed-boom hydraulic equipment, mix the fungicide, such as zineb, with water at the rate of 2 pounds per 100 gallons. Usually apply about 150 gallons of this formulation per acre. Three pounds of the fungicide applied in this way can be formulated in as little as 40 gallons of water and used to spray an acre with about as good results, provided the proper equipment is used. This concentrated formulation in 40 gallons of water is called a "4×" concentrate, since it is approximately

equivalent to 8, or more accurately $2\frac{1}{2} \times 3$, pounds of zineb per 100 gallons of water.

This so-called low-gallonage spraying is most commonly done with an airblast (mist) sprayer and is used to some extent in spraying muskmelons. With this machine a concentrated formulation of the fungicide is introduced into a horizontal blast of air, which is driven across the rows at high velocity. Most of this airblast spraying is done with 4× or 5× fungicide-water combinations applied at 40 or 32 gallons per acre, respectively.

In airblast spraying the driveways must be so arranged that the spray swath overlaps in the center of the area between them. A machine with an air capacity of 20,000 cubic feet per minute and an outlet velocity of 90 to 100 miles per hour can spray a 35- to 40-foot swath effectively. On this basis the driveways should be from 70 to 80 feet apart.

Do not use airblast sprayers when the wind velocity is over 7 to 8 miles per hour. Stronger winds do not permit good coverage of all the plants. In spraying muskmelons the airblast must be properly directed, particularly with regard to the rows close to the machine, or the vines will be moved too much when they are small. Airblast spraying is becoming popular because it saves time, but it has not yet been completely determined whether this method gives fully as good control of muskmelon diseases as conventional hydraulic spraying.

When fungicides are applied as dusts, use a power machine and apply 40 to 60 pounds per acre. Machines should be equipped with two or three nozzles that discharge equal amounts of dust. Dust when the air is quiet, and stop if the wind interferes with good coverage of the plants. Early morning and late afternoon are usually favorable times for dusting.

Fungicides for Muskmelon-Disease Control

Captan.—Captan has been used to control anthracnose (p. 26) and alternaria leaf blight (p. 27). Use it at 3 pounds per acre. In high-gallonage spraying add 2 pounds of captan to 100 gallons of water and apply 150 gallons per acre.

Captan also may be used as a dust containing 5 to 10 percent of the fungicide.

Fixed Copper Compounds.—The fixed copper fungicides are relatively insoluble forms of copper that are used without the addition of lime. They are effective against downy mildew (p. 25), but not equal to such fungicides as zineb (p. 39) or ziram (p. 39) to control anthracnose (p. 26) or alternaria leaf blight (p. 27). Several fixed copper compounds are sold under various trade names. Their copper content varies from 13 to 55 percent. Some of these formulations and some of their trade names are as follows:

Basic copper sulfates: 53 percent of copper (Basi-Cop, Duo Copper, Orchard Brand 530, Tennessee Tri-Basic Copper Sulfate); 26 percent of copper (Corona "26" and Tennessee 26).

Copper oxychloride sulfate: 55 percent of copper (Niagara C–O–C–S).

Copper calcium oxychloride: 46 percent of copper (DuPont Copper–A Compound).

Copper hydroxysulfate: 13 percent of copper (Copper Hydro Bordo).

As field sprays for muskmelons, the fixed coppers are prepared to give an equivalent of $1\frac{1}{2}$ pounds of copper, calculated as metallic copper, per 100 gallons of water. When applied at 150 gallons per acre, this is equivalent to $4\frac{1}{2}$ pounds per acre of a compound containing 50 percent of copper.

The copper content of the different compounds is shown on the

package, and the amount of material needed can be calculated from this percentage. For example, 6 pounds of a compound containing 25 percent of copper would be needed to give 1½ pounds of copper per 100 gallons of spray in the field, whereas only 3 pounds of a compound containing 50 percent of copper would be used. Before using the fixed copper compounds, consult your county agricultural agent or State agricultural college as to the compounds that have proved most effective for field use in your locality.

The fixed coppers also are used as dusts, which seem to be fairly satisfactory. Dusts containing 5 percent of actual copper are recommended for use on muskmelons.

Nabam.—Nabam is used in liquid form. In making a spray for muskmelons, add 2 quarts of the commercial product to 100 gallons of water. Then add to this solution 1 pound of zinc sulfate, which is dissolved in water. Usually apply at the rate of 3 quarts of nabam plus 1½ pounds of zinc sulfate per acre. When this formula is followed, the reaction product is very similar to zineb (p. 39). Nabam plus zinc sulfate gives good control of downy mildew (p. 25), alternaria leaf blight (p. 27), and anthracnose (p. 26).

Zineb.—Zineb is effectively used to control downy mildew (p. 25) and alternaria leaf blight (p. 27). It also is fairly effective in controlling anthracnose (p. 26). Use it at the rate of 3 pounds per acre. In high-gallonage spraying add 2 pounds of zineb to 100 gallons of water and apply 150 gallons per acre.

Dusts containing 5 to 8 percent of zineb may be used for muskmelon-disease control. However, spraying is likely to give more satisfactory results.

Ziram.—Ziram is very effective in controlling anthracnose (p. 26), and it also gives fairly good control of alternaria leaf blight (p. 27). It does not control downy mildew (p. 25). Apply ziram at 3 pounds per acre. In high-gallonage spraying add 2 pounds of ziram to 100 gallons of water and apply 150 gallons per acre. A mixture of 1 pound of ziram and 2 pounds of a 50-percent fixed copper compound in 100 gallons of water per acre gives fairly good control of both anthracnose and downy mildew.

Although spraying is preferable to dusting, ziram may be used on muskmelons as a dust containing 7 to 10 percent of this fungicide.

HARVESTING AND HANDLING

Successful marketing of muskmelons depends largely on careful gathering and handling. Where the plants are grown in long rows and large blocks, the vines of about every tenth row should be laid carefully together when ripening begins so as to clear roadways for use in hauling away the crop. Where field roads run at right angles to the rows, the pickers work toward these roads and deposit the melons at the roadsides to be picked up by trucks or trailers.

Muskmelons do not attain their finest flavor and best eating qualities unless they are harvested as they approach maturity. At this stage the sugar content, flavor, and texture improve rapidly. After the fruit is picked, its sugar content does not increase, but the texture may improve for a short time after harvest. Sweetness, flavor, and texture are best in fruit that is harvested when its sugar content is high. Fruit picked when immature never develops this high quality. Melons left too long on the vine lose sugar and soften while being packed and shipped.

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FIGURE 24.—Muskmelon picked at the full-slip stage of maturity. Note that the stem has pulled away from the melon, leaving a clean, cuplike hole.

Overripe fruit also is especially subject to decay-producing bacteria and fungi. The marketing of immature or overripe melons can often damage later sales of high-quality fruit.

Western growers now commonly grade the "cantaloup" types of muskmelons into three maturity classes. These are, in ascending order of ripeness, "hard ripe," "eastern choice," and "western choice." All of these are harvested at "full slip," that is, entire separation of the stem from the melon under slight pressure, so that a clean stem scar remains (fig. 24). Full-slip melons require faster and more thorough precooling than the less mature "part slip" fruit, which formerly constituted part of the shipment to eastern markets.

Transit temperatures consistently below 40° F. are also essential, particularly for the eastern choice melons. However, these full-slip melons ripen more uniformly and with generally better quality than less mature melons. Muskmelons shipped from western-producing areas are now consistently harvested at the full-slip stage.

The distinction between hard ripe, eastern choice, and western choice is almost entirely based on surface color. Hard ripe melons are light green to yellow green at the sutures and between the netting, whereas eastern choice fruit has a greenish-yellow to light-yellow undercolor on substantial areas of the surface. The western choice melons are approaching the full-ripe condition, with much strong yellow undercolor and slight springiness at the blossom end. As the name implies, they are sold in western markets and mostly within a few hundred miles of origin.

Experienced pickers soon learn to recognize and are able to judge accurately at a glance the stage of ripeness of melons by their general appearance—mainly by the color of the background.

The condition known as full slip indicates ripeness accurately only for melons of the netted type that are borne on healthy plants under favorable weather conditions. Often rainy weather, disease, insect infestation, and other factors cause melons to separate from the vines when they are still unripe and inedible, particularly in the Eastern States.

The stem does not separate from the fruit of Honey Dew, Honey Ball, Crenshaw, Casaba, and Persian varieties at maturity as it does from the "cantaloup" varieties. Maturity of these semikeeping muskmelons must be determined by a certain yellowing of the skin and a slight yielding of the blossom end when lightly pressed. Considerable experience is needed to judge the harvest maturity of these varieties. They should be cut from the vine to prevent injury to the stem end of the fruit.

It is desirable that muskmelons ripen on the vines. However, the fruit should be harvested before it is too soft, as it may be damaged in handling. It is possible to overstock a market with soft melons, particularly near the end of the picking season. The vines should be gone over about every other day during the first week of the picking season and every day of the second week. The first melons mature slowly. As the season advances, ripening becomes more rapid. Toward the end of the season the oftener the suitably ripe melons are gathered the better.

The right way to remove a muskmelon from the vine is to press on the stem with the thumb or slightly lift the melon from the ground. If the melon is ripe enough to be picked, the stem will separate from the fruit.

Hampers, baskets, crates, and other types of containers are used for gathering muskmelons. Generally the melons are hauled to the packing shed in the picking containers. A very large part of the crop is gathered into canvas sacks holding about a crate of melons each. These sacks are carried on the backs of the workmen and are emptied directly into padded trailers and trucks, which are on nearby roadways or straddling the field rows. The trailers may be 6 to 8 feet wide and 15 feet long. When loaded, they are usually hauled directly into the packinghouse. Melons gathered in sacks are more likely to be bruised than those gathered in baskets or crates. Often no picking containers are used; the melons are merely laid in piles. Then men on the ground toss the melons to men on the truck, who place them in bulk in the truck or

trailer. This kind of handling is likely to lead to damage. Muskmelons should not be handled roughly and preferably should be gathered in baskets or crates.

After the melons are gathered, no time should be lost in removing them to the packing shed. Exposure in the field to the sun is likely to cause them to soften very rapidly. A load to be hauled a considerable distance should be protected from the sun with a canvas cover.

GRADING AND PACKING

The oldtime temporary packing shed constructed in the muskmelon field has very largely been replaced by the permanent shed or packinghouse serving a large acreage of muskmelons. A central packing shed is usually located on a railway siding with access to a main highway so that the melons that are graded and packed in it can be loaded directly into refrigerator cars and trucks. Melons collected at a central point, from large acreages, can be graded and packed more uniformly than in the field. A saving results also from not having to haul the shipping crates to the farm and back again. At a central shed where skilled workers are available and a capable foreman is in charge. more uniform sizing and better grading can usually be obtained than when packing is done on the farm.

In modern packinghouses muskmelons are unloaded from the padded trucks or trailers directly onto conveyor belts, which carry them past sorters who throw out the culls. The melons then may pass through a waxer, which coats them with wax dissolved in a petroleum-ether solvent. Next they pass along a belt where they are classified on the basis of maturity, in accordance with the distance to the markets to be supplied. In the West, where a very large part of the commercial muskmelon crop is produced, the yellowish ripe melons, which are good for local markets, are commonly graded as "local choice," and melons that are full slip but not too ripe to stand a trip to distant markets if well precooled and refrigerated are graded as "terminal quality."

The sorters who classify the melons as to maturity place them in bins. The packers work from these bins, each doing his own sizing. As the crates are packed, they are placed on a conveyor belt and carried to the lidder or the lidding machine. The number of melons in each crate is stamped on the crate. When the crates are removed from the conveyor, they are grouped according to melon size and maturity, so that carlots can easily be made up according to the distance to the markets.

Muskmelon growers of California, Colorado, and Arizona sometimes ship their product in jumbo crates 13 by 13 by 22⅛ inches. Often they pack the larger melons in jumbo flat crates 5 inches deep, 14½ inches wide, and 22⅛ inches long. In these States the standard muskmelon crate is 12 by 12 by 22⅛ inches, pony crates are usually 11 by 11 by 22⅛ inches, and flats are 4 by 12 by 22⅛ inches or 4½ by 13½ by 22⅛ inches, all inside measurements. Eastern growers have not adopted any standard crate dimensions and use crates varying considerably from these measurements.

Until 1957 the wooden jumbo slat crate was the accepted crate for western muskmelons. However, breakage of this container during transit and physical damage to the melons from the slat edges have caused a definite trend to other containers. Jumbo crates of slightly

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FIGURE 25.—Standard muskmelon pack of 45 melons in a standard 12- by 12- by 22⅛-inch crate.

larger dimensions and with paneled ends are replacing the old slat crate. The new crates do not require the excessive lidding pressure and high bulge of the old crates. Furthermore, the combination of paneled ends, cleated lid, and smaller bulge of the new jumbo crates permit crosswise loading in the car or truck. This in turn substantially reduces container breakage as compared with that incurred in the lengthwise loads, which were standard for the old crates.

In addition to modifications of the jumbo crate, several smaller containers are coming into use. The most common are fiberboard boxes and wirebound crates, which are designed for a two- rather than a three-layer pack and so contain two-thirds of the quantity contained in the jumbo crate. The outside dimensions, except for depth, and the pack arrangement within a single layer are the same as those for similar melon sizes in the larger crates. Thus packers can convert readily from one container to another, and both types can easily be handled on conveyors, hand trucks, and other equipment.

The large markets of the United States have come to recognize as "standard" a pack consisting of 45 muskmelons in the standard 12- by 12- by 22⅛-inch crate (fig. 25). To make this pack, the melons must be 4 but not over 4½ inches in diameter. This pack has a depth of three layers, each layer containing three rows of five melons each. The melons are placed end to end lengthwise in the crate and completely fill the length of the crate. Slightly larger melons are often packed 36 to the standard crate.

Extra-large melons (over 5 inches in diameter) are usually packed in a jumbo crate. It consists of 36, 33, 27, or 24 melons, according to melon size, and the arrangement varies according to the size and shape of the individual melons. In many areas the pony crate is not used. However, small melons are packed 54 to 60 in the standard crate, and those so small that 60

would not fill a crate are generally discarded. Flat crates are packed 9, 12, or 15 melons to a crate according to the size of the individual melons.

Growers in Maryland and Delaware use crates 12 by 12, 13 by 13, or 14 by 14 inches with slats 22 to 26 inches long, usually packing 36 melons to a crate. They also use two-third crates 10 by 15 and 9½ by 14 inches, packing 24 melons to a crate, and 5- by 15-, 5½- by 16½-, and 6- by 18-inch crates with slats 22 to 30 inches long, usually packing 12 melons to a crate. The tub bushel basket is used in Maryland and Delaware.

North and South Carolina growers use standard crates 12 by 12 by 22 inches, two-third crates 8 by 12 by 22 inches, and also bushel baskets.

The pack always should be snug and so full that it bulges slightly to allow for shrinkage in transit. Melons that are slack packed shift about during handling and are likely to become bruised, with the result that they fail to bring full price when they reach the market. The crates should be loaded into refrigerator cars or upon trucks as rapidly as they are packed and should be sent to market in the shortest possible time. When the packing is done under field shelters, the melons should be protected from the sun at all times, especially after they are graded and packed in the shipping crates.

Muskmelons that are well netted, clean, and smooth and are packed in neat, attractive crates appear the best on the market. Wrapping individual melons in tissue paper before packing them in crates for shipment makes them attractive, but it is not advisable as the paper interferes with the cooling of melons in a refrigerator car and often causes them to mold in transit. Well-designed colored labels on the ends of the crates add materially to the appearance of the package. The color work on these labels should not be overdone, and the label should not misrepresent the contents of the crate as to variety, grade, or locality where grown. In a few shipping sections it is common practice to place a small paper or plastic sticker on each melon.

Rough handling must be avoided all along the line.

LOCAL MARKETING

Increase in automobile travel has created an excellent opportunity for local production and sale of muskmelons. By means of truck transportation, markets up to several hundred miles from the point of origin can be supplied with vine-ripened melons of high quality. A well-located, well-managed roadside market soon gains a patronage that takes care of a considerable acreage of melons. Often a market is established temporarily on a main highway for the sole purpose of handling a muskmelon crop. Often, also, at a roadside market that is rather permanent and offers other farm products, the melons can be made a "special" during their season.

One melon grower follows the practice of leasing acreage suitable for muskmelon production within a mile of a central point on the main highway, where he can establish his market during the period when the melons will be ready for sale. This grower plants only on land that has not been in melons for several years, usually on land in bluegrass or clover sod; he sprays regularly and produces high-grade melons. He hauls the melons from the fields to the market in small motor trucks. There he grades the melons according to size and freedom from de-

fect and displays them in bins facing the roadway. Many of his best customers drive from the nearby city primarily to get a supply of fine-quality melons, and they usually buy considerable quantities, including melons that are fully ripe and some that will keep for 3 or 4 days. Usually the customers bring baskets with them. The dealer keeps a few bushel baskets and hampers on hand for sale, but otherwise he does not provide any containers.

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